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April 10, 1961

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A fastener specialist at a large aircraft corporation, through extensive tests, has recently proved the importance of the clamp-up factor in sonic fatigue performance. Superior clamp-up is a strong characteristic of Voi-Shan's new V-Bolt blind fastener, a mechanical property now recognized as vital in combating sonic fatigue. The V-Bolt achieves a wide range of requirements in the difficult-to-obtain structural assembly function, in addition to its many generic purposes: relies on a high quality fastener, simplicity and efficiency of design in the V-Bolt allow a flexibility of use, this allows an immediate switch to V-Bolt is encountered in a variety of materials to Voi-Shan's renowned high standards of excellence. It is available in a range of diameters 5/32" to 3/8" in both round-shank and hexagonal head configurations from stock. Other sizes available on request. Industry's high shear and tensile strength requirements are easily surpassed by the V-Bolt. • Existing crimp tools are used for either head style V-Bolt installation.

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Hence, when the first astronaut is launched on his special journey . . . Reeves and VERLORT will be on duty at every tracking station . . . a dependable lifeline to earth through every moment of his flight and return.

Wherever your needs may be in the fields of guidance and tracking radars, from ground systems to outer space, the use of Reeves exceptional proven capabilities and capabilities should be your first consideration.

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Windshield icing and fogging problems are considerably more complex for jet airliners, compared with those encountered by piston engine planes. With jet thrust, faster speeds, higher altitudes, plus greater extremes in temperatures and atmospheric pressure, many new problems develop. Magnetic Controls' proportional heat control systems have helped to solve these problems for Over 800 jets. The Magnetic Controls systems offer four distinct advantages:

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AVIATION CALENDAR

(Continued from page 5)

- International Flying Aces' Team, MCM College, College Station, Tex.
- Apr. 16-May 4—Fourth National Aerospace Instrumentation Symposium, Instrument Society of America, Adolphus Hotel, Houston, Tex.
- May 24—Electronic Components Conference, Institute of Radio Engineers, Jack Tru Hotel, San Francisco, Calif.
- May 15-17th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D.C.
- May 14—Nuclear Applications in Space Conference, American Rocket Society/ Oak Ridge National Laboratory, Gatlinburg, Tenn.
- May 14—Second National Symposium on Space Factors in Electronics, Institute of Radio Engineers, Marriott-Town Lodge, Miami Hotel, Arlington, Va.
- May 14-16—National Aerospace Electronics Conference, IRE, Miami and Biltmore Hotel, Daytona, Fla.
- May 14-16—General Meeting, Airport Operators Council, Cavalier Hotel, Miami Beach, Fla. (AOC American Society of Civil Engineers' Joint Session, "The Airport Operator's Report Session," May 11-12.)
- May 14-16—Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.
- May 14-16—Ferry, Office of Scientific Research, Lyndon and Research in honor of the 10th Anniversary of Theodore von Kármán, Sheraton Park Hotel, Washington, D.C.
- May 12-16—National Aeronautics Association Convention, Hotel Bradford, Boston, Mass.
- May 15-16—Aviation Fire Safety Seminar and Exhibition, Bureau National Fire Protection Assn., Hilton Statler Hotel, Detroit, Mich.
- May 17-17—National Symposium on Space Wave Theory and Techniques, IRE, Sheraton Park Hotel, Washington, D.C.
- May 15-16—30th Annual National Conference, Society of American Weight Engineers, Sheraton Hotel, Akron, Ohio.
- May 22-24—National Telecommunications Conference, Sheraton Towers Hotel, Chicago, Ill.
- May 23-24—Fifth National Symposium on Global Communications, Institute of Radio Engineers, Hotel Shamrock, Chicago, Ill.
- May 20-June 4—24th French International Air Show, Le Bourget, Paris, France.
- May 24-June 2—University of Michigan's Second Annual Radio Symposium, Ann Arbor, Mich.
- June 13-17th National Microwave and Operations Meeting, Bowling Aviation Service, Inc., Reading, Pa.
- June 19-19—National Joint Meeting, in state of the Aerospace Sciences and American Rocket Society, Ambassador Hotel, Los Angeles, Calif.
- July 25-Aug. 18—International Traffic Fair and Exposition, Ederheim, McCarran, Park Convention Center, Chicago, Ill.
- Sept. 4-20—1961 Flying Display and Exhibition, Society of British Aerial Constructors, Farnborough, England.



Avco's AN/VBC-12 night vision FM communication system.

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DIVISION

Avco and... better communication in combat areas

The newest combat area FM communication equipment standardized by the U. S. Army Signal Corps is Avco's AN/VBC-12.

Designed, developed and produced by Avco's Electronics and Ordnance Division, the AN/VBC-12 covers ultra-high narrow-band frequency modulation, covers 30-30 megacycles, has 220 channels and offers completely automatic tuning.

Rugged and compact — one-eighth the size and two-thirds the weight of the equipment it replaces — the AN/VBC-12 is compatible in every way with existing, portable and airborne FM radio sets being developed by the Army for use in forward combat areas.

Reducing the problems and enhancing the effectiveness of communications whether for the Army, Navy, Air Force or MACV — are among Avco's proven and most highly developed capabilities.

If you have a communications problem, why not consult Avco's Electronics and Ordnance Division. Whether Director of Marking, Communications Section, Electronics and Ordnance Division, Avco Corporation, Cincinnati 18, Ohio.

Avco's AN/VBC-12 combat area FM communication system.



A new switch on jet starting for the Boeing 727

The Sandering dual-purpose electrical starter-drive for the new Boeing 727 short-range jetliner offers many operating and cost advantages.

This new starter-drive is derived from reliable Sandstrand constant speed drives that power the electrical systems of the Boeing 767, 730, 8-82, and the Douglas DC-8.

It combines the two functions of engine starting and transmission of power to a constant frequency ac electrical generator, in a single lightweight unit integrated into the design of the 727's turbocharged auxiliary with the PAM-2TRD-1 turboshaft engine. A single on-off switch per engine selects the mode of operation.

This new system also permits electric cross-starting from a single idling engine — allows the use of 400-cycle electrical ground service through a single ramp outlet — minimizes ground handling equipment for starting engines — and provides power for electrical system check-out without engine light-up.

Considerable savings in weight, initial test errors, and maintenance are obtained by eliminating the separate starter. The starter-drive is warranted for 2500 hours of operation. Overhaul expense, maintenance, and operating costs have been greatly reduced. Write or call your nearest Sandstrand Aviation office for complete details.

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As a result of development by the Magnavox Company in conjunction with the Navy Department, every Chance Vought F4U Corsair Fighter Pilot sees the target at a glance—day or night, in any kind of weather.

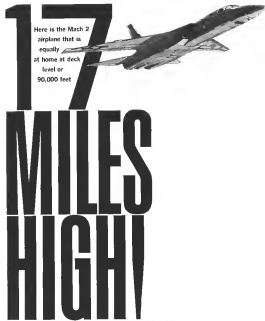
Here are the eyes of a modern weapons system... a component that delivers the range, weight and reliability so absolutely necessary to successful tactical operations.

This airborne radar system is just one of many systems which have been and are being designed and produced to satisfy the tactical requirements of the military services in the fields of Communications, Airborne Radar, ASW, Navigation, Fueling and Data Handling.

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AIRBORNE FIRE CONTROL RADAR



Here is the Mach 2
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at home at deck
level or
90,000 feet

IT IS CALLED THE A3J VIGILANTE

It is the airplane that flew to a new world's altitude record for aircraft carrying a payload of 2,204 pounds. The Navy's A3J climbed to over 91,450 feet to set this record, more than 24,554 feet higher than the previous record set by a Russian jet aircraft. And this versatile aircraft has outstanding low-altitude capability, too. It handles easily. Gets in and out...in a hurry. It can carry out high or low level attack missions in any weather, day or night. It can operate from carriers or small space airfields. It can fly at very high altitudes faster than the earth turns beneath it. This is truly one of the most practical, dependable, business-like airplanes in America's airborne arsenal today. This is the A3J Vigilante.

THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION

Columbus, Ohio



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32 years ago Kodak

Kodak didn't really get started on making reliable systems for data processing and handling until 1925. There were no magnetic tapes in those days, but long strips of film did prove handy for helping banks keep track of checks. The machine we built for doing this was the Recordak Model 1 microfilming machine, one is pictured on the right.

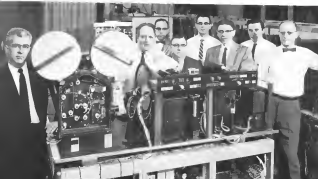
Except for when the banks took a short rest around March, 1933, this machine and its vastly more improved descendants have been serving the banks ever since. Approaching half a trillion in business documents handled for banks and almost every other enterprise, they have gone far beyond mere record-keeping. They have graduated to automatic looking, continuous updating of directories, and even the making of human beings.

Today Kodak's Apparatus and Optical Division is a force in being that makes advanced microfilming techniques with sophisticated com-



puter gear. Below is a picture of one such use of this machine, and the engineers who created it. This device will input a computer tape or search the computer's memory,

obtain instructions on how to draw letters and characters from a character-generating device, and put perfect, uniform characters directly on microfilm at a lightning rate.



got its start in the data handling field



Here is a picture of a little slip of film, small as it actually is. Notice that it contains a hole, plus some digital data and some tiny photographs. These three parts play a significant role in an automatic library that handles both abstract ideas and pictures, cross-references

everything, and responds to the most complicated questions by delivering text, charts, maps, photographs, and documents in a form that a man can read to bed, secure regulations penetrating. The chips below are the Kodak force in being that created this library system. The little slips of film, of course, are never touched by human hands. It's largely a pushbutton operation.

Users find it worth every kishnook.

Yes, we know how to force photography to make significant sense for storing and working with digital and analog data. Have you heard about the photographic plate* that can store the multimillion-bit program of instructions for arranging a nation's telephone long-distance lines to handle the Mother's Day traffic?

*It costs \$5, before exposure.



↑ The system on the left is called "Dancer" and the one above is called "Minicard." Information about them is supplied by Recordak Corporation, 615 Madison Avenue, New York 17, N. Y. (subsidiary of Eastman Kodak Company). We are trying to advertise them here. They are merely drucktable examples of what Kodak does in pioneering and building appliances on the present borders of feasible technology.

Should we meet and talk of the connection between our capabilities and your problems?

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RECORDING
RETRIEVAL
CONTROL

For a booklet that succinctly summarizes our work in any one of these fields, write: Customer Relations Department.



because positive, reliable engine anti-icing was essential...



Shown: Full size mockup of new Chinook helicopter

Vertol Division of Boeing selected Vap-Air Inline Valves for their new "Chinook" Helicopters

Vertol Division's new "Chinook" Helicopters are engineered for demanding day-in, day-out all-weather service. Powered by two dependable high-performance Lycoming T-55-L-6 gas turbine engines, operational reliability and safety were essential considerations in the "Chinook" design.

To ensure positive, reliable engine anti-icing protection, Vap-Air Inline Valves were selected for engine bleed-air shut-off. Compact, light weight, and of simple design, these valves have only one moving part. They combine the advantages of fast action and tight closure, with low weight-to-size ratio.

The Vap-Air Inline Valve shown is designed to operate from sea-level to 20,000 feet, at duct pressures from 4 to 50 psig, duct temperatures from -65°F. to 400°F., and ambient temperatures from -60°F. to 300°F. Other models available for temperatures to 800°F. and ambients to 800°F.

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Who saw the Crab Nebula first?

The Crab Nebula was born on the fourth of July, 1054, and was one of the most spectacular explosions in man's recorded history. Despite the fact that it was visible all over the earth in broad daylight, the actions of a few Chinese astrologers are all that give a clue to its birth.

Today the most minute disturbance in the skies brings histories of J. W. Fecker telescopes and tracking devices instantly to bear. The Crab Nebula was lost for 700 years before it was found by astronomers of the 19th century. A recent nebula was picked up by three observatories on a

many continents within 15 seconds of each other!

J. W. Fecker is the country's oldest manufacturer of telescopes. Its product development in the fields of advanced optics and electrical, hydraulic, pneumatic control is used by government, industrial and private institutions the world over. Our laboratories and manufacturing facilities are available for projects in all of these fields.

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Convair 540 Conversion with Napier Jet-Prop Engines



Convair 540s undergoing modification with Napier Jet-Prop engines at AirResearch Aviation Service, the most experienced company in the modification of pressurized aircraft.

AirResearch Aviation Service converts Convair 540s and 440s into high performance airliners and executive aircraft with Napier Jet-Prop engines specifically designed for the Convair 540.

With over weather cruising speed of 325 mph and payload (except capacity of 66 passengers for 800 miles or 18 executive transcontinental routes), the Napier Jet-Prop 540 provides a smoother ride at greatly reduced noise levels and improves economy of operation in airline or business transport.

An AirResearch auxiliary gas turbine installation (optional equipment) makes the Convair 540 self sufficient on any landing strip. The on-board unit provides complete engine starting and all power for ground air conditioning and preflight checkout.

Installation of the 5800 shp Napier "Eland 504" Jet-Prop engines with four-bladed propellers includes

structural modification to engine nacelles, new instrumentation, and electronic and radio system modification to maintain down time.

Conversion of Convair 540s and 440s to Napier-powered Jet-Prop 540s is performed exclusively at AirResearch Aviation Service, the most experienced company in the modification of Convair 540s, 540s and 540s into executive aircraft and luxury airliners.

Employing more than 600 of the most highly trained and experienced engineers, technicians and craftsmen in the industry, AirResearch performs all design, engineering, fabrication and installation work in one location to meet the conversion, modification, maintenance and overhaul requirements of any aircraft.

Write, wire or telephone today for complete information regarding your Convair 540 conversion with Napier Jet-Prop engines.

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THIS IS AN ENEMY BOMBER. NORTHROP BUILDS IT.

On a radar screen, the RP-76 target missile can look as big as the largest enemy bomber. Rocket powered, it flies faster than sound, operates above 70,000 feet. Yet this little giant is less than ten feet long, weighs just over 300 pounds, and parachutes down for re-use after completing its run. It is the heart of the Army's program for training the ground-to-air missile crews who guard our cities. The complete target and tracking system is made,

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EDITORIAL

Polaris on Station

During the past five months, a radically new element has been added to the U.S. strategic deterrent posture by the Polaris solid-fueled ballistic missiles deployed under the sea in nuclear-powered submarines. The Polaris-firing submarines George Washington and Patrick Henry have already made successful combat runs carrying their multi-nuclear loads to the ocean depths for more than two months at a time. The Robert E. Lee has completed its firing trials and is due for its first combat patrol soon, while the Theodore Roosevelt is at the start of its firing tests on the Atlantic Missile Range. It will be followed in combat status by the Abraham Lincoln and Ethan Allen. By coincidence, there will be six of these submarines simultaneously, carrying a total of 96 Polaris missiles on station as a significant increase in both the quantity and survivability of our deterrent force.

The submarine-carrying Polaris is not an invulnerable weapon system nor is it the sole answer to the problem of deterrence in the nuclear era. But it does add a unique element of complexity to any potential enemy's aggressive intentions, and it makes its contribution within a time-scale of enormous significance in the current and near future international balance of military power.

Along with the land-based land-based ICBMs and the airborne Hound Dog and Skybolt missiles, the Polaris submarines should form a deterrent pattern of sufficient firepower, dispersal and survivability from surprise attack to provide a stable deterrent force in the nuclear era.

In so far as when traditional types of military organizations have become less and less able to cope with the problems posed by them by the galloping technologies of our times, the Polaris program provides one of the best examples of a military technological management pattern that effectively harnessed the new technologies to a military problem within a short enough time period to be significant in the international power scale.

Although the Polaris program now encompasses nearly 9,000 organizations down through its third tier of subcontractors and has utilized the resources of universities, research institutes and other government agencies, it began with a single Navy admiral—Rudolf Raborn, his single assistant and a piece of paper signed by the chief of naval operations that said simply: "Give this other whomever he needs."

The period from the creation of Navy's Special Projects Office in December, 1955, to study the problem of developing ballistic missiles for attack of sea to the date the George Washington put to sea for its first combat patrol Nov. 15, 1960 was less than half the normal military development cycle time for a new weapon system. From the time the Polaris was officially approved as a project in its present form on June 1, 1957, to the time that summer when its effective combat duty Polaris submarines have will be deployed will be only four years—a truly remarkable record.

The Polaris program has pushed many basic state-of-

the-art advances along a wide spectrum of technology. With Atlantic Research Corporation's breakthrough on specific impetus, it sparked a resurgence of interest in solid propellants and maintained the techniques of employing large solid-fueled rocket motors in addition to developing new high temperature alloys to permit better performance. Sparked by Dr. Stark Draper's Massachusetts Institute of Technology missile guidance group, the Polaris guidance system presented the challenge of this equipment into extremely small packages of high precision performance. Submarine navigation was developed to 10 times its earlier precision, and basic new techniques of high speed work in entry that evolved from Polaris development have been applied to other types of ICBMs.

These technical advances are still continuing and, as an extremely interesting facet of the Polaris management techniques, have been carefully scaled in time to produce a constantly improving missile from the original 1,200-mile range A1 now in use to the 1,500-mile A2 and the 1,300-mile A3 model whose development will be accelerated under the new defense budget.

From the navy's viewpoint, this provides a most interesting aspect too rapid obsolescence of the multi-billion dollar investment in the Polaris weapon system. From the military viewpoint, it provides the Polaris system with increased survivability by permitting the submarines to operate and fire further out in the ocean where their detection, pursuit and attack becomes even more difficult for an enemy that has so-and-here along the Atlantic sea.

Polaris also produced significant state-of-the-art advances in the techniques of military technical management. This management pattern, pioneered by Admiral Raborn and his crew, with Lockheed Missiles & Space Division as prime missile system manager, should be carefully studied as a prime example of how to approach the increasingly complex problems of welding scientific, industrial and economic resources into the desired end product fast enough to be significant either in military or political competition. The PERT electronic management device developed in the Polaris program has been the foundation for a variety of similar systems now being widely used in industry.

Among the other outstanding management achievements in Polaris are the interrelationships of highly complex components, such as gyro, produced by its own four separate sources, the sharing of responsibility with authority all down the management chain, and the streamlined overhead that used only 700 persons, including clerical help, to manage what was at better than a billion-dollar a year program.

The Polaris program is a heartening example of what this country's technology, industry and military leadership can accomplish when they organize properly and proceed with firm decisions toward a well-defined goal. No matter how far out as the technical horizon it can learn at the outset.

—Robert Heits



RECONNAISSANCE, THE LACK OF IT, AND A FAULTY COMMAND

The year is 1862. The Army of the Potomac, during this early phase of the Civil War, Union reconnaissance do battle. Facing them, General John B. Magruder's divisions of the Confederate Army of Northern Virginia firmly entrenched before Richmond, but numbering only 15,000. The sheer weight of Federal men and equipment is apparently sufficient to gain the victory, destroy the Southern force, capture the Confederate capital and perhaps end the war. But General George B. McClellan, the Union Commander, never orders the advance. Why?

During the years preceding the war, adequate provisions for reconnaissance had not been made. McClellan's intelligence, directed by the famous detective Allan Pinkerton, underestimated the strength of the Confederate forces . . . overestimated their forces to be more than of

the Army of the Potomac. During this early phase of the Civil War, Union reconnaissance do battle. Facing them, General John B. Magruder's divisions of the Confederate Army of Northern Virginia firmly entrenched before Richmond, but numbering only 15,000. The sheer weight of Federal men and equipment is apparently sufficient to gain the victory, destroy the Southern force, capture the Confederate capital and perhaps end the war. But General George B. McClellan, the Union Commander, never orders the advance. Why?

From the beginnings of communications on the face of the earth, reconnaissance has helped shape history. Today CAl's specialty in this area is helping shape history to the advantage of the Free World. Typical of CAl's capabilities are: VAP: Visual Integrated Presentations, data display system; K&D: the world's most versatile aerial camera; S&D: the only electro-optical "binoculars" now in production.



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WHO'S WHERE

In the Front Office

Monty J. Peale, president of Republic Aeronautics Corp., elected a director of Lockheed, Inc., Burbank, N.Y.
Edgar S. Baker, director of research at Hughes Aircraft Corp., Los Angeles, Calif.
James L. Jorda, Jr., board chairman, and **George A. Sanderson**, vice chairman, both from Co., Wallingford, Mass. Alfred E. Lombard succeeds Mr. Jorda as president.
Dr. E. M. Lewis, a director, The Boeing Corp., Bellevue, Wash., is elected a director of Philadelphia's Philadelphia University of the Sciences Institute.
Clifton F. Walker, corporate president, elected a director of Vought Aircraft Co., Dallas, Texas.
Paul H. Ryan, president, Cessna Corp., Van Nuys, N.Y.

L. E. Burt, vice president and general manager, Low-Brower Division of Lear, Inc., Warren, Ohio.

John J. Hartley, vice president corporate marketing, Kalamazoo, Mich. **William D. H. C. Briggs**, vice president, Collins Radio International, CA, with offices in London, England.

Dr. Richard E. Hildreth, vice president, research, AeroVitality Corp., Cambridge, MA.
Dr. James H. Gardner, a vice president, Standard Research Corp., Cambridge, Mass. Dr. Gardner continues as general manager of the United Division.

John E. Lillick, vice president manufacturing, Shalton Manufacturing Co., Schaumburg, Ill. **Clarence W. Shook**, vice president engineering.

John B. Clark, vice president, Systems Division of Comptek Corp., Houston, TX.

J. Fred Nathaniel, corporate vice president, International Electronics Co., Philadelphia, Pa.

Dr. Ernest Watanabe, a vice president of Aeronautics Division of Lockheed Industries, Menlo Park, N.Y. **Dr. Watanabe** is director of the Advanced Design Laboratory of Aeronautics.

R. J. Miller, vice president, Alvin Associates, Torrance, Calif.

H. Richard Alexander, vice president, David Corp., Los Angeles, Calif.

Leonard J. Lyons, vice president director of engineering, American Vacuum Inc., Los Angeles, Calif. a director of Aero Science Corp.

Albert P. Myhring, vice president and general manager of a newly created Space Electronics Division of Space Electronics Corp., Glendale, Calif.

Changes

George H. Buchanan, manager contracts and contract support, Corning Glass Division of General Dynamics Corp., Grand Rapids, Mich.

Edwin J. Jackson, senior technical sales manager engineering, General Electric Co. is transferred to Department West Coast Manufacturing Co. Cook, public relations manager, Cook's Division of Lockheed Aircraft Corp., Burbank, Calif.

E. S. Bennett, manager, vice manager, Pacific Aeronautics Corp., Los Angeles, Calif. (Continued on page 104)

INDUSTRY OBSERVER

•Team of Hughes Aircraft and Glavin Vought is offering to build a communications satellite and launch it into a synchronous equatorial orbit with a Scout booster for \$33 million under a fixed-price contract in evidence of their confidence that they can do the job. From a small satellite out of launching from Japan Island, a U.S. Pacific island near the equator. This has been proposed to Defense Department and several communications command centers. Price is based on providing five vehicles and satellites to meet successful orbit.

•Proposed request for display language input (SLRI), which would supplement Air Force's airborne language input (ALRI), was to be issued last this year. ALRI is an airborne data processing system developed by the SAGE system, and SLRI would add capability for supplementary surface warning of airborne threats. Airborne tests of ALRI are being flown from Olathe, Kan., and are scheduled to be completed in early 1963.

•Second Short SC-1 VTOL research aircraft, ordered by the company at Bellair development, is being modified for afterburner flight with a variable landing system. Request proposal is to control deceleration before landing. More than 100 SC-1 complete transitions have been made in first flight, and the first "jump" takeoff has been made from a solid runway in spite of its unbalanced ground effect compared with a slotted platform.

•USAF's Project Atlas (aerodynamic structural stress evolution tests) calls for launching of six or seven hypersonic glide models on the Space Scout booster to study the effects of heating on structures of the type that will be used on Doan and advanced boost-boost vehicles. Glider will be fired to velocities of 19,000 to 20,000 ft/sec, and altitudes reaching 400,000 ft.

•Initial development of Army's Western Electric Douglas Nike Zeus anti-ICBM missile is nearly 600 ft. To get this enormous high performance, development of the 47 in. 22,000 ft/sec missile is expected to have accounted for about a third of total system development costs. In production, all volume elements of the system are expected to amount to 17% of the total cost of a minimum strength Zeus missile.

•Weight Air Development Division will support a new study of how various materials withstand high intensity electromagnetic radiation under various circumstances. Contract award is expected shortly.

•Finalized VZ-5 deflected trajectory VTOL test vehicle is still undergoing wind tunnel testing at NASA's Langley Research Center. It is expected shortly to join the other Army VTOL vehicles, which have been in flight status for several months.

•Army has completed plans to launch a series of Space Segment missiles from San Nicholas Island into the Pacific Missile Range's sea test ranges. The flights had been authorized to determine how test sites performed in the high desert climate of White Sands Missile Range is altered in humid, sea level operation.

•Several CAl Contract launching pads which handle Atlas-boosted space vehicles may be given solid vehicle capability under various contracts. ALRI and NASA are studying. One plan calls for Pad 12, which already has been used for Atlas-Agena in the Vela program, to handle both Atlas-Agena and Atlas-Centaur vehicles, for Pad 13 to handle both Atlas-Agena and Atlas-Centaur, for Pad 14 to handle Mercury only, and the Pad 360 now scheduled only for Centaur—to handle both Atlas and Atlas-Agena.

•Navy has been investigating possible use of an optical sensor capable of generating coherent beams of yellow-green light at a wavelength of 5461 Angstroms. Higher frequency electromagnetic energy, including light waves, generally are attenuated severely under water, but a window in the yellow-green portion of the visible light spectrum can penetrate light of this color to travel over relatively long distances under water.

SILICOLOGY

Studies in Silicones

HOW THESE TIME-TESTED MATERIALS
CAN WORK FOR YOU

For Shear Reliability— Design with Silicone Fluids

Some of the most outstanding things that hydraulic systems are doing today are being done by and because of silicon fluids. In automotive applications, for instance, they're the lifeblood of certain big-boring hydraulic transmissions, power steering, speed-and-temperature-regulated fans. In aviation and other fields, you'll find them in sensitive gyroscopes, damping devices, liquid springs, valve lifters.

MANY USEFUL PROPERTIES

Of course, designing with a stress requires knowledge of the stress fluid's behavior. Knowledge of its many temperature properties, oxidative and thermal stability, viscosity, thermal expansion, effect on rubber seals of all kinds, compressibility, and apparent viscosity vs. shear rate.

This last is particularly important. And the well-documented viscosity curve of Union Carbide Silicone Fluids comes backed with their unique "temperature stability" (remember that changing mass fluid temperature) makes them among the most dependable of hydraulic fluids.

You may have heard or discovered for yourself that silicone fluids make electronic seals shrink and may even have discovered them from your consideration, much as you would like to take advantage of their other properties. Then here is some.

EFFECT ON RUBBER SEALS

Union Carbide has conducted extensive studies of the effect of silicone on various elastomers, and has shown how this problem can be easily met by the use of proper additives in the fluids. In the accompanying table you can see, for example, how "Plenol" B91 additive (Rohm & Haas) in silicone affects the per cent volume change of Nipponese W rubber. Similar data covers just about every light, transparent oil, synthetic oil, etc. Moreover, these data are available on many other natural and synthetic rubber compounds.

How can you get them? They're available now, along with much other important information including new detailed shear viscosity curves. Just mail the coupon for our latest "Design File" on

Union Carbide Silicone Fluids for Mechanical Applications. It provides in one handy package just about everything you need to know about silicone fluids for your projects.

Effect of Silicone Oil
on Nipponese W Rubber

Silicone Fluid	% Volume Change	
	7 days 70°F	4 days 100°F
30% L-45	-0.50	-0.10
30% L-45	-0.47	-0.05
30% L-45	-0.38	-0.03
30% L-45 + 2.4% B91		
Plenol B91	4.02	3.70
30% L-45 + 2.4% B91		
Plenol B91	17.32	18.00
L-45	1.30	10.00
Wetral	6.70	13.70

*Approximate

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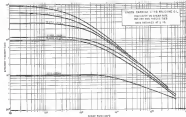
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Disarmament Studies

Washington Roundup

John T. McChes, the President's disarmament adviser, and Walter Heller, chief of the President's Council of Economic Advisors, have held preliminary talks on the possibilities of conducting studies of the international and domestic aspects of various disarmament plans.

Both groups, named last week by the President as special assistants to McChes, will continue to direct the comprehensive study of the Senate Foreign Relations Subcommittee on Disarmament (AW Feb. 13, p. 26) on the impact of the proliferation of defense weapons on major defense contractors, as well as on business generally. She was formerly staff director for the subcommittee. The study is nearing completion.

Meanwhile, draft proposals of legislation to establish a disarmament organization—either in State Department or as an independent agency—are being circulated among top executive branch officials for comment.

Atomic Energy Commission does not plan to accept its nuclear and materials research program toward any aircraft nuclear propulsion (ANP) applications. Instead, it will devote its former ANP funds into its broad research program on reaction and materials.

The agency also wants to move this research from the General Electric and Pratt & Whitney ANP facilities and into its own laboratory at Livermore, Calif. It claims the customers' facilities are too expensive for the amount of work that would remain there.

Air Force is recommending that President Kennedy's proposed acceleration of the placement of B-47 strategic bomber wings be postponed for a year. In the past year, B-47 wings already have been reduced from 20 to 13, leaving out a total of 115 aircraft.

Joint Fighter Project

Defense Secretary Robert McNamara is insisting that the F-10X tactical fighter, which originally was an Air Force proposal, be developed as a two-service project. He was what he considered duplication in the SYOC fighter area and wanted a cross-industry Defense's research and engineering office backed over the requirements of the three services and found them incompatible. But McNamara now has sent a team from that office out to ask manufacturers if the various requirements can be incorporated into one aircraft.

At the same time, Air Force is under pressure to consider using the Navy McDonnell F-4H. In the General Electric J79 engine give it some 16,000 lb. of thrust, and Marine Corps is operating it out at 3,000 ft. wings.

Reorganization at the Air Staff level to conform with the new Air Force Systems Command and Air Force Logistics Command structure will turn the former deputy chief of staff-command office into deputy chief of staff-systems and logistics. It will be headed by Lt. Gen. Mark B. Redfield, Jr., who now holds the national post. He will have two deputies—one for systems, one for logistics. Maj. Gen. Nelson C. Dewley, now director of aerospace systems development under the deputy chief of staff development, is slated for the systems job, and Maj. Gen. W. C. Senter, now assistant deputy chief of staff for systems, is to go to the logistics job.

The general deputy chief of staff development office will become deputy chief of staff-systems and technology, with the new Office of Aerospace Research reporting to it. Lt. Gen. Roscoe C. Wilson, now deputy for development, would head the research and technology office.

Space Council Change

Legislation to change the national space act so Vice President Lyndon Johnson can head the National Aeronautics and Space Council is expected to go to Capitol Hill this week. The present intention is to make the council a national space program planning body rather than just a body for setting priorities.

While President Kennedy will ask advice from the council, he will not abandon his present practice of soliciting space advice from individuals—chiefly Johnson, presidential science advisor James B. Watson and the administrator and deputy administrator of National Aeronautics and Space Administration.

While the presidential science advisor James B. Watson to create a panel on space-booster to determine which of these now in development should continue, whether tax cuts are needed and whether Air Force or National Aeronautics and Space Administration should develop new new ones that are needed.

Air Force will reduce the number of Study Requirements (SRs) and limit their lifespan back to about 10 years in most instances, following criticism that these study efforts are taking up many of the nation's best scientific minds. In the future, Under Secretary Joseph Chapple must approve initiation of all SRs.

—Washington Staff

port sounding rocket and satellite launches, information exchange and exchange of scientific personnel (AW Apr. 3, p. 33).

An absolute mutual cooperation exists, the U.S. and Italy have agreed to launch rockets from coast-to-coast from Wallops Island, Va., and Sanjose in Costa Rica in a location of mutual interest and direction. The experiments will start late this month or in May.

Agreements similar to that signed by U.S. and France is expected soon between U.S. and Japan, which recently sent a task group to that country to discuss sounding rocket and satellite experiments.

FCC Begins Exploratory Probe Of Communication Satellite Issues

Washington—Federal Communications Commission has launched an inquiry into new administrative and regulatory questions raised by the prospect of commercial operations with communication satellites.

The move reflects growing concern in some government circles over the close-coupled neighborhood of space communication systems. Results of the heavy initial investment required radio spectrum licenses and the demand for such facilities anticipated in the near future, some observers believe not only are, at this time, uncertain and cannot easily be published in the foreseeable future. The FCC inquiry is based on this premise.

The commission has asked industry, including the communication companies, to detail their views on how commercial space communication systems should be viewed and operated in the framework of existing laws and policies, to how such laws should have to be modified to accommodate their proposed plan.

Companies, which are to submit their views by May 1, also are asked to state whether they intend to participate in the proposed plan and the extent of their participation.

American Telephone & Telegraph Co. has indicated publicly its intention to proceed with development and implementation of a commercial space communication system, using private capital, providing it obtains government authorization. The details of efforts may depend upon which company is selected by the National Aeronautics and Space Administration to develop its Project Rella communication satellite system, since this would give the contractor a lead over competitors.

The prospect of a single commercial space communication system, at least initially, FCC said, raises the question

of maintaining the U.S. policy of fostering beneficial competition among privately owned and operated international communication communication carriers and of operating within the framework of existing national laws.

The purpose of the new inquiry, the commission said, is to determine various methods by which all interested in international communication carriers and officials can participate "on an equitable, non-discriminatory and lawful basis."

In a statement circulated by AT&T shortly before the current FCC action, the company said it did not wish to evaluate other international carriers either from criticizing such systems or from sharing the aim of the system proposed by AT&T. "We wish only the opportunity to explain private enterprise, management and capital in the public interest and under public regulation in a manner which is consistent with traditional public policy with respect to international communication."

The Bell System said its proposed space communication system facilities would be made available to all international communication carriers serving the U.S. for any services they may want, or use in the future, by mutual agreement with the FCC. Participation by other companies would be made available on an equitable basis either by extending participation through private sharing of the capital investment and operating expenses or by lease arrangements. AT&T now leases some circuits as its transatlantic jet phone cable for use in international telephone companies.

Some observers see the latest AT&T offer as a concession to the idea of a system owned and operated by a coalition of companies, at a means of avoiding the charge of a private monopoly.

in space. The offer also has been quoted by the recent proposal of Lockheed to form a "common-carrier carrier" company for a space communication system (AW Mar. 20, p. 28).

The FCC is now seeking the views of other communication carriers and interested companies, asking for their suggestions for the best plan of participation in operating a space communication system within the framework of existing policies and laws. The commission asks the companies whether such a plan should include participation by manufacturers of satellite communication and launching equipment. Industry is asked to specify in detail the technical and operational arrangements of the plan for the agencies.

The bureau is placed in a position to specify how proposals would comply with existing provisions of the Communications Act of 1934 and applicable antitrust statutes. Where a proposed plan does not comply, the commission is asked to recommend specific changes that would be required in that law to permit adoption of the plan proposed.

FCC also asks for a statement of the extent to which each of the several parties to the plan would be subject to regulation by the commission at various points or otherwise.

Bambi Contractors

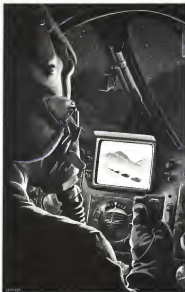
As Farn has been denied to avoid such contracts in the acquisition of ballistic missiles in the Soviet Union, under Project Bambi to General Dynamics Corp. a Contract Division and to Space Technology Laboratories Inc. A third study contract is apparently being awarded to the latter, which is the other firm in the competition, being sponsored by Advanced Research Program Agency, Air Force's Ballistic Systems Division and Aerospace Corp.

Competition includes, in addition to Convair and STL, the three contractors of North American Aviation, Republic, Electro-Optical Systems and International Business Machines Corp., institutions composed of Hughes Aircraft, McDonnell Aircraft, Aero and United Technology Corp., Boeing Aerospace Co. and Raytheon Co. among The Hughes team is believed to be favored for the third study contract.

Convair also is engaged in a failed Air Force study in a related field under Project Spool, which is protection of the defense, which is related to ballistic missile interception in its facilities during Soviet STL has been performing studies under studies related to missile launch modes of interception by the Bambi contractors. Convair has been studied by AeroGeneral and Boeing.

How science serves Defense at Westinghouse

WESTINGHOUSE IMAGING SYSTEM ENABLES PILOTS TO SEE HOSTILE GROUND TARGETS ON DARK NIGHTS



Installed in combat aircraft as standard, the new Westinghouse low-light level imaging system clearly pinpoints tactical targets normally observed on cloudy, moonless nights. The system is equally effective for target-viewing systems in tanks or submarines.

Military pilots can now viewing ground targets and terrain features at night, instantly, with a new low light level electronic imaging system being developed at Westinghouse.

The new system will see hundreds of times better than the human eye under darkest night conditions. It is simple, compact, and rugged, utilizing advanced versions of the small Avcon high amplifying tube, a product of Westinghouse research. Systems using this tube will automatically track, identify, and simultaneously present a full field of view.

Westinghouse, at its Air Arm Division in Baltimore, is also applying results of six years of research in electronic imaging systems to advanced and ultra-violet systems, planned for space programs.

The new imaging systems, coupled with traditional Air Arm capabilities in fire control, reconnaissance, surveillance, and missile guidance, offer potent new levels of military strength for the free world. — They are another demonstration of how science is serving Defense at



Westinghouse



Advanced Westinghouse thermal imaging systems for space applications permit accurate detection and tracking of ballistic missiles, satellites, or spacecraft. These systems feature high scan speeds, high resolution, and inherent reliability. Low power consumption means weight and space savings.



Weather mapping the world is but one of the many jobs which can be performed with advanced Westinghouse infrared systems.



Westinghouse Lycon ultraviolet imaging system will enable man to see a UV picture of the atmosphere, taken from above the atmosphere.

Infrared, Ultraviolet imaging systems being developed for new space missions

Advanced imaging systems utilizing infrared and ultraviolet spectra are being developed at Westinghouse for a variety of military and scientific uses.

At the Air Arm Division in Baltimore, active and passive thermal imaging systems are being planned around advanced infrared devices, including the Westinghouse Space Thermion Mission include target detection, tracking and guidance, reconnaissance, surveillance, and mapping. A key factor in these systems is the successful application of ultra-thin, infrared-sensitive membranes developed by Westinghouse scientists.

Westinghouse has also developed the Lycon imaging tube sensitive to shortwave ultraviolet rays such as those emitted by celestial bodies but which are absorbed by our atmosphere. In space vehicles, systems using Lycon will give us a new view of the universe.

These new IR and UV imaging systems, plus sophisticated advances in visible light systems, offer America potent new military and scientific capabilities. They are another demonstration of how science is serving Defense at



Westinghouse

Determining the Proper Depth of Case in Alloy Steels

In one of the recent articles in this series we discussed the carburizing of alloy steels, pointing out that the purpose of carburizing is to provide a hard, abrasion-resistant outer shell or "case." Such a discussion naturally gives rise to the question, What factors influence the choice of case? Should it be shallow? Medium? Deep or extra-deep?

While it is not always wise to formulate hard-and-fast rules, the following may be used as a general yardstick:

Shallow case (less than 0.02 in.). Suitable where wear-resistance alone is the chief requirement, and where good surface condition after heat-treating is advantageous. Not suitable if high stresses are apt to be encountered in service.

Medium case (0.02 to 0.04 in.). For high wear-resistance. Will stand up under substantial service loads and stresses. The thickness is sufficient to permit certain finishing operations, such as light grinding.

Medium-to-deep case (0.04 to 0.06 in.). For high wear-resistance. A case in this depth range is essential where continuing friction is involved, especially friction of an abrasive or semi-abrasive nature. It is also a good precautionary

measure where application of the finished part may sometimes involve crushing action.

Extra-deep case (more than 0.06 in.). Cases of this depth can be obtained by extending the furnace time in pack carburizing. Highly wear-resistant, extra-deep cases also withstand shock and impact. A large crankshaft of an internal-combustion engine is a good example of a part requiring the extra-deep case. This is especially true of the cam lobes themselves.

If you need advice concerning case-hardened parts, let us arrange for one of our metallurgists to assist you. Bethlehem engineers are always on call, and you can depend on their recommendations. And you can depend on Bethlehem, too, when you need alloy steels, for Bethlehem makes the full range of AISI standard grades, as well as special analysis steels and all carbon grades.

This series of alloy steel advertising inserts is now available as a compact booklet, "Quick Facts about Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

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$$I_{sp} = \frac{F_n}{\dot{m} p}$$

Problem: Nozzle ejector thrust augmentation . another advanced program at Martin

requiring the talents of those persons who are seeking creative freedom and greater professional stature in conceptual areas beyond the usual. To participate, write directly to N.M. Pagan, Director of Technical & Scientific Staffing, (Dept. B-3), The Martin Company, P.O. Box 179, Denver 1, Colorado.

MARTIN
GREENBERG ASSOCIATES

Fairchild Records \$6-Million Loss

Fairchild Engine and Airplane Co. reported a net loss of \$5,691,618 for 1968, most of it due to additional write-downs on the F-27 turboprop transport which still is in production on a limited basis.

The F-27 has not shown better last fall, but four aircraft now are under construction without specific orders for them and a limited number may be built after that.

Of five engines built last year without orders, four have been sold on the last four months.

The F-27 write-down of \$5,200,000 was made on the basis that the airplane could not be sold at an aviation price at current prices in quantities now assembled.

With the write-down, the company expects at least to break even on its 1968 sales.

Somebody of the write-downs caused anticipated losses on various military shipments. The company's major subcontract program for B-52 subsonic jets, was not troubled.

Following the policy announced last year with the change in top management of the company calling for cutbacks to reduce or cancel non-aviation projects such as International Marine and Sparrow, but aluminum bridges, James Aircraft Corp., buyer of F-27 assemblies at a plant at Broward, Okla. Aerobics Division, high-light sport and military rifles, and the Pioneer Research were sold or closed.

Seeks Defense Business

Edward C. Vile, Fairchild's new president, sold stockholders that Fairchild would concentrate henceforth primarily on defense business and would seek to diversify the technical skills of the company rather than its products. The former retired jet and engine designer, but never ran the character of the industry before, he said.

Early this year Fairchild arranged a new line of bank credit for a maximum of \$12 million. Chase Manhattan Bank of New York is now the lead bank of a group of five, and Bankers Trust Co. formerly the lead bank, has dropped out of the lending group along with others.

Fairchild sales totaled \$93,896,946 in 1968 compared with \$114,668,435 the year before. The company reported that a \$1,515,241 profit in 1969, but had posted a \$24 million net loss the year before.

Net worth dropped to \$15,576,242 from \$23,572,882 the year before as a result of the new write-down. Back log at the end of 1968 was \$45 million compared with \$70 million the year before.

Other financial reports

*General Electric Equipment Corp. reported net profit of \$1,032,660, or \$1.46 a share on sales of \$224,427,956 in 1968. Figures for the year before were \$4,198,306 profit, or \$2.65 a share on sales of \$213,588,499.

Lofti Tests Confirm Space Uses for VLF

Washington—Feasibility of using very low frequency (VLF) radio for space vehicle guidance and for communications from sub-orbital submarines (in a remote form) has been confirmed by results of recent tests using Naval Research Laboratory's Lofti satellite.

The satellite, launched Feb. 21 in a piggy-back experiment, failed to detach itself from Transit 11B and the last booster stage, but it operated for about six weeks before being driven off space nearby.

Lofti's analysis of Lofti data to date indicates that VLF waves (15-30 kc) partially penetrate the ionosphere as well as being reflected from it, confirming previous theory. Signals transmitted at VLF from a ground station to the Pioneer Grand Force were transmitted by the satellite at VLF frequencies to NRL, mobile and National Aeronautics and Space Administration ground stations.

While VLF signals do penetrate water and are no automatic launch has prompted their use by Navy for submarine communications, but has acquired enormous importance and possibly ground stations to achieve global coverage.

New data suggests feasibility of using low-power stations for trans missions to a distant satellite which would sub-orbital at VLF to sub-orbital in its vicinity.

NRL scientists report that data received so far indicates that VLF waves travel at less than the speed of light, the velocity at which all higher frequency radio waves are thought to travel.

Velocity depends upon signal path geometry and local atmospheric conditions, data indicates.

Another observation, of secondary phase delay as much as 8 second from previous pulse transmissions, suggests they are being taken travel along the earth's lines of magnetic force from northern to southern hemisphere and back.

Naval Research Laboratory plans to launch three or four more Lofti satellites, including one capable of transmitting and receiving at VLF frequencies.

News Digest

Trans-Canada Air Lines completed a preliminary inspection of landing gear assemblies on its fleet of eight Vickers Vanguard aircraft last week. Inspectors will check one of the main gear was found to make a belly landing at Montreal Apr. 1 because the right main gear failed to descend. Problems was traced to failure of the right wheel shock to position properly, jamming the gear down. No malfunctions were discovered on the remaining Vanguards.

Air Force is transferring 16 C-130s from the 85th Air Division, Scott AFB, Texas, to the 32nd Air Division, Denver AFB, Texas, to supplement present airlift capability in Europe and to provide Tactical Air Command fighters with three with anti-theater airlift.

Bell 480-B, powered by Lycoming TVO-115 piston engine containing an Allison T-41 turbo-driven supercharger, will be marketed by the Ft. Worth, Tex., helicopter manufacturer as Max. This model replaces 475-1 due to surface controllability of Franklin's turbocharged engines. Sea level performance to more than 15,000 ft. is claimed for new aircraft at maximum gross weight of 2,500 lb., about 500 lb. greater than the earlier 475-G.

North Aviation has an \$86,000 Air Force design study contract to determine the characteristics of a turbine engine powerplant. The French firm will study the design and operation field with its Griffon research aircraft.

Northwest Airlines last week reported 1968 net earnings of \$1.6 million, compared with a 1969 profit of \$1.7 million. Gross revenues of \$28.1 million, down 2.1% from those of the previous year.

Trans World Airlines earned a net profit of \$6.4 million from both international and domestic operations in 1968, compared with net profit of \$4.4 million for 1967. Gross revenues reached \$378.5 million as 5.7% increase over 1967. Operating expenses for the year climbed 9.4% to \$362.1 million.

General Electric Missile and Space Vehicle Department will conduct a \$100,000, one-year National Aeronautics and Space Administration study of the feasibility of a magnetron-driven, solid-state engine for space applications.



THREE Sikorsky S-61Bs for Los Angeles Airways are on the ramp at the Skyway plant. Certification and delivery are expected this summer. Forward part of the passenger cabin can be converted to cargo space.

Los Angeles Airways Expands With S-61s

By William H. Gregory

Los Angeles—Deliveries this summer of large helicopter-converted helicopters capable of carrying substantial payloads of mail and passengers at the same time will produce a fundamental change in the character of Los Angeles Airways.

Until now, carriage of mail required under the airport's inland, proximity to the airport, and has prevented full exploitation of the potential passenger business in this rich urban industrial and tourist region.

Integration of five Sikorsky S-61Bs—three this year and two next—into the aircraft unit will bring other changes in addition to the increasing volume of passenger business:

- Increased frequencies because of the higher speeds of the new aircraft.
 - Pressure for larger markets. Los Angeles Airways already has filed with the Civil Aeronautics Board for routes as far as Santa Barbara and Edwards AFB in the north, San Diego to the south and Lake Arrowhead to the east. Other routes and resources may open a further possibility.
 - Revised fare structure. Fares now do not reflect passenger weight, but cargo and tend to produce the longer hauls.
 - Modified maintenance procedures and increased number of maintenance personnel.
- The airline has projected carrying a half-million passengers annually in 1965 compared with the 40,000 level of last year, but Robert Heides, vice president-traffic and sales, believes that with proper permission this is

far from right will be doubled. By way of comparison, the airline carried 5,163,661 lb. of mail and 3,093,000 lb. of air cargo in 1960.

One big advantage the helicopter carrier has is the existence of 20 heliports in the Los Angeles area and the willingness of local governments to provide new ones. A city center heliport now is under consideration on downtown Los Angeles and S-61 passenger service might be possible to the downtown area this year.

Present routes of Los Angeles Airways are divided into five segments for schedule making and statistics purposes. Segments A and C (see map) are the shortest one route to Oakland. Air Terminal on the north end has been dismantled to the south. Segment B is the route to San Bernardino to the east and about half the distance of the other two. Shuttle service to the Los Angeles area just after departure is denied in Segment B.

Segment D is used to exploring passenger service to the inland location of the S-61 fleet of which only one is the newest Los Angeles Airways fleet and the most recently. An S-61 was not full of mail, but the past office man have nothing coming back. Lack of maintenance shops, traffic and insurance experts has hampered development of a passenger market. Even in all-passenger configuration, the S-61 will carry only 6-7.

Los Angeles Airways' S-61s will be fitted with a 50-in-dia removable baggage pod forward on the left side of the fuselage and two bins at the rear side on the right side with a total

of 57-cu-ft capacity, for a 1,200-lb total. All double seats on the left forward of the cargo door can be folded by the wall and scattered toward the passenger side by a removable partition for added cargo space.

With this flexible passenger-cargo configuration, the aircraft will go into two new phases of operation. One is the initiation of domestic Los Angeles passenger service. The other will be a change to look out of the airport to where service is a time-proven and build an aircraft service for business men or shoppers, a service that has possibilities in the Los Angeles area because of its geographical dispersion and lack of public surface transportation.

S-61 service also will permit Los Angeles Airways the opportunity to tap the potential of a heavy tourist market, California Island, because of its partly not needed to leave the aircraft established routes.

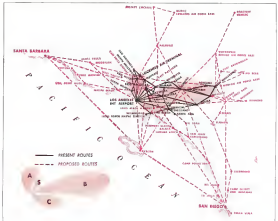
During the summer, the airline plans to make more than a day or possible on the 20th day. Right. It also has its potential to serve as a balance for the down market where traffic would be heavier during the winter.

Besides the new services to develop from Los Angeles and California, Los Angeles Airways plans to begin flights to three other new heliports expected to be available.

- Newport-Burbank. This would be an other tourist market to service a new area.
- Pasadena and the west San Fernando Valley area. Both are growing industrial and residential areas.
- San Bernardino with its heliports



MAIL IS UNLOADED from Los Angeles Airways S-61s on rotary heliport at the downtown Los Angeles post office loop. First office shuttle service is made segment B on only (shown) which shows present and proposed route for the service. Other under segments are divided A, B and C for scheduling and scheduling purposes. Maps potential market for the service is Los Angeles California Island which is shown as a proposed route, but which actually has been declared by CAA as part of the carrier's route area. Other extensions are pending before the Board. San Bernardino segment B is the biggest passenger traffic demand point on the system at the present time and Los Angeles Airways believes S-61 capacity and speed can stimulate more traffic.





Dramatic proof of AeroShell Oil W stability. Piston (left) ran for 250 hours using a good standard mineral oil. Connecting rod (right) ran using AeroShell Oil W. Note remarkable cleanliness.

BULLETIN:

Shell answers the ten questions you might ask about AeroShell Oil W—world's first non-ash dispersant aircraft oil

Less oil consumption. Longer intervals between engine overhauls. Easier starting, faster warm-up, reduced wear on piston rings, cylinder bores, cam lobes, lifter faces, gears and bushings.

All these benefits have been obtained with new AeroShell® Oil W. Here, in handy question-answer form, are the facts.

1. What types of aircraft can use AeroShell Oil W? Piston engine planes of any size. Helicopters, too.

2. Why is it called a non-ash dispersant oil? Because it contains special additives that help keep ash, ingested particles in the oil from clumping together and forming deposits. These particles remain suspended and dispersed until they burn.

3. How does this affect engine performance? It means that engine parts stay cleaner. That lubrication points get all the oil they need. Your engine runs more efficiently, parts last longer.

4. What about oil consumption? Because AeroShell Oil W means decreased wear and a cleaner engine, you can expect less oil consumption.

5. Can AeroShell Oil W reduce my maintenance costs? If you have been

using a single mineral oil, AeroShell Oil W can reduce your maintenance costs substantially. Lessen your engine run duration and cooler Oil consumption is less. Thus you can extend intervals between engine overhauls.

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mainde fighter center, now is the major passenger traffic projection point.

Three operations expenses are estimated at \$773,501 this year, rising to \$715,840 next year, leaving a profit in 1964 of \$908,321 and dropping off slightly thereafter. Direct maintenance estimated at \$24,141 this year, will rise to \$657,000 next year and level off at the \$700,000/710,000 area for the rest of the period.

Total operating expenses will exceed total revenue through 1964, the airline companies but fall to \$7,797,692 in 1965, above \$40,000 less than total estimated revenue. It is evident Los Angeles Airways does not expect to profit substantially operating with the first generation of turbo-powered helicopters. The gap will be narrowing, however.

The airline is seeking a guarantee for a \$2,991,677 loan from the fleet of Airways for four of the five ships, whose total cost is \$3,212,910. The remainder and the fifth ship will be financed out of cash flow, largely from depreciation and amortization.

High equipment depreciation on the \$-61s will rise from an estimated \$197,699 this year to \$493,473 next year and will continue at about that level through 1965.

Typical fares currently from Inland airport run \$6 to Alhambra, \$7 to Disneyland, and \$8 to San Bernardino, the highest fare in the schedule. These fares are based on a load factor of 0.10 mi., rate of \$5.57 including tax, rate \$6.10, 10.20 mi. at \$5, suburban zone, 20.40 mi. of \$7, and extended area zone, 40.05 mi. of \$9. Thus the fare to San Bernardino of \$8 is only \$1 more than the fare to Disneyland, which is only about half the distance.

Revised Schedule

The airline is preparing a revised schedule calling for a five-34 landing charge, plus a dollar for curb 10 mi. The 10-mi. local zone fare would be \$5 under the schedule, the Disneyland fare the same as it is now, and San Bernardino fare \$30. Not only the CAB requires such a schedule, but it also must be approved by the California Public Utilities Commission, which may be a tougher job to complete.

Maintenance problems with the \$-61s will be harder to solve, now as it did with the \$-62 (AW Apr. 1, p. 40). General Electric will produce engine overhaul at its Ontario, Calif., plant but Los Angeles Airways will do turbine inspection and engine overhaul and inspection. Added operations expenses, it expects to provide longer base hours, overhaul than the \$-62, at its engine and \$30 in on-gate hours not applicable for air carrier service.

Under construction is a progressive overhead system now used in fixed-wing aircraft.

\$61 Operating Cost Estimates

Los Angeles Airways estimates the \$-61H operating costs will level off at 19 cents per available seat mile in 1964 and 1965 after a 35-cent start-up and transition costs are out of the way.

In its application for a guaranteed loan now being processed by the Civil Aeronautics Board, the airline proposes a five-year contract. The first five years include the \$15 payment. The contract:

- Cost per available seat mile, 27 cents in 1962, 17 cents in 1963, 16 cents in 1964 and 1965.
- Cost per revenue passenger mile flown: 91 cents in 1961, 42 cents in 1962, 31 cents in 1963, 27 cents in 1964, and 25 cents in 1965.

- Cost per available seat mile, \$2.10 in 1961, \$1.41 in 1962, \$1.33 in 1963, \$1.33 in 1964, and \$1.31 in 1965.

- Cost per revenue passenger mile flown: \$5.60 in 1961, \$3.50 in 1962, \$3.50 in 1963, \$3.50 in 1964, and \$3.50 in 1965.

Costs are unit-adjusted and index-adjusted and are based on cost-of-labor factors of 49.40% in 1960, 49.70% in 1964 and 49.90% in 1965.

aircraft. This would double the aircraft into 10 zones, each representing progressively at various hourly levels, the highest aircraft cost at the lower end of the spectrum. Instead of having a step down for \$10 in a zone with the \$55, only it would be required for an individual case operation.

The airline is also seeking a system from a maintenance standpoint, want it requires more personnel, it is efficient from the aspect of aircraft utilization. The system would be so calculated that the aircraft would be kept at peak periods.

Many pilots will be needed, since the \$-61 will require a cockpit, a pilot may not now necessary with the \$-62 or \$-64.

Looking to the future, the airline has filed an application with the CAB to begin local service as the San Francisco area. A guarantee of family unity is another factor, says Marvin F. Began, a member Los Angeles Airways vice president, his goal is San Francisco and is changing an area, purchase two \$-61s to begin a San Francisco Airport to Oakland service.

Industry helicopter service: Los Angeles-San Francisco, for example, is not out of the question now as being competitive in fare with fixed-wing service, but a guarantee of family unity is not competitive. The competitive look for the near term future—consequently and it may—about 100 mi., Los Angeles Airways believes

City	Time in Minutes		
	Seattle	Los Angeles	San Francisco
Albany	25	17	17
Burbank	25	17	17
Ontario	140	30	34
San Bernardino	360	30	34
San Francisco	120	30	13

Seattle has given the airline a projection of operating costs of \$2 cents per passenger mile at a 90% load factor. In its revised local application with the CAB, the airline estimates \$-61 passenger revenues to increase from \$778,784 this year to \$1,577,719 next year and \$2,265,234 the following year. By 1965, the airline estimates passenger



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CAB Bars Hasty Future Merger Action

By L. L. Dots

Washington—Civil Aeronautics Board decision last week, which gave United Air Lines forced authority to acquire Capital Airlines only after approval after the merger agreement was filed, has quashed earlier hopes that future large-scale merger proposals would be handled with equal speed.

Throughout the 10-day opinion, the Board broadly hinted that it views of the course it was forced to follow in approving the merger were dictated by the fact that it can no longer afford to enter into making Capital from its fixed capital. It said "Notwithstanding the manifest implications of the merger in terms of maintaining a balanced transportation system, we find that the public interest in preserving a collapse of the Capital system outweighs whatever short-term gains may accrue to the merger."

In separate comments, two of the four participating Board members, Chairman Allen S. Rand and G. Joseph Minetti, explained they would have preferred broader studies of Capital's problems as an alternative to merger and added that they were not going with the decision because it was not clear in it will meet when the consolidation is consummated. Little and recent Board member Robert Murphy, did not take part in the vote.

Rand said the Board should have studied the possibilities of expanding or transferring Capital's routes at the time the merger agreement was filed. He added that such action is not possible because of Capital's previous financial condition.

Minetti is a dissenting vote with his separate comments, felt otherwise. He stated that steps would still be taken to keep Capital alive while an investigation of the effects the merger would have on the industry was being conducted. Minetti also doubted that United would reject the merger now. The Board to remove the New York Atlanta New Orleans route from the merged system. Both Delta and Eastern have stated that United's competition on this route would result in damage to the two carriers. Minetti added:

"It goes some the merger agreement with Capital is a concern of future operations, but United's decision does not mean that the merger would affect the merger area if a small portion of the anticipated gains from the transaction were denied it." United, in submitting the merger proposal to the Board, stated that it would keep the merger plan unless all of Capital's assets were transferred to the merged company.

Generally, the Board agreed to the conditions in its final decision. However, to protect Mahan and Allegheny it placed these restrictions on the merger:

- United will be prohibited from providing service between Hamburg, Ky. and New York and between Washington and Pittsburgh.
- No service will be permitted between Philadelphia and Pittsburgh except on flights originating or terminating at Omaha or points west.
- Single plane route between Buffalo and Detroit to United will be prohibited.

General tone of the majority opinion was that the Capital-United merger agreement was a unique case, and that the Board was not establishing a new policy by expediting and approving the agreement. It stated that its opinion was based in large part upon the need for protecting the financial integrity of Capital to protect the financial integrity of the airline industry.

It stated that the "unintentional" approval of this proposed merger agreement does not produce the Board from taking a second look at the matter in the future in the event that circumstances develop with respect to these routes which are not covered by the Board's decision.

It is now apparent that the Board does not anticipate similar economic problems and that in any future case strong consideration will be given to such factors as overall route structure, traffic, fleet composition and capacity. In its decision, the Board said the United-Capital merger approval will not provide future merger applications, such merger will be decided on its own merits. No new procedures have been established and that past judgments on merger cases do not preclude approval of the United-Capital merger.

In approving the merger, the Board had done a number of other positive provisions similar to those applied in previous merger cases. These provisions are designed primarily to ensure fair integration of assets rather than to ensure that United's competition on this route will be placed in a more position with respect to competition as a result of the merger and to provide for equitable distribution and financial efficiency.

- For the transportation purposes, merger approval shall not be relied upon by United as a basis for negotiating the commercial value of assets acquired or as a basis for determining the commercial value in excess of the price paid for such assets.
- In accounting for the merger transac-

tion, assets and liabilities shall be transferred to United at the value shown on the books of Capital, with any difference between book value and purchase price to be taken in the acquisition adjustment account and held in suspense until all adjustments have been made for assets not directly a part of the acquisition adjustment account. Late last week, United said it agrees to the conditions laid down by the Board and that immediate steps will be taken to consummate the two companies. The airline reports to complete the merger process by June 1.

After the six-day merger steps that must be taken before the merger project is completed.

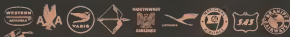
- Payments for accommodations must be filed within the next 10 days. Answers to such petitions must be filed within the following 10 days.
- Board will then give its decision on the consolidation petition.
- Conditions pending the merger decision may take a short time at the decision, but this action must be taken within 60 days of the date of the Board's decision, which is April 3.
- United must file the financial statements of the conditions attached to the approval of the merger.
- Merger will be legally final when United files the merger agreement with the Securities and Exchange Commission, in which the carrier is incorporated.

American Profit Drops As Revenues Increase

Washington—American Airlines last week reported a 19% increase in gross revenue for 1960, a 40% decrease in 1960 profits despite a 114% increase in revenues.

Reported for the year ended 1960, American's gross revenue grew 19% over 1959. Net operating capital for the year was \$577 million, compared with \$753 million the previous year. In its annual report, American Airlines stated that the decline in profits was due to a sharp drop in the cost of fuel and a sharp increase in the cost of labor and maintenance.

- Growth in traffic during the year was less than last year because of a slowing down in the economy and a sharp increase in the cost of fuel and maintenance.
- Total fixed investment in aircraft and equipment was \$111 million.
- Total fixed investment in aircraft and equipment was \$111 million.
- Total fixed investment in aircraft and equipment was \$111 million.



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Bermuda Fosters Midwest Tourist Market

By Gino Gerson

Hamilton—Tourist-supported island of Bermuda is looking the aspect of the jet transport, which travel people have regard as something of a mixed blessing.

Jet service has brought Bermuda less than two hours from New York, but the jet also has cut losses in what is north in the Caribbean and Bermuda fears a loss of business in these once remote localities.

As a countermeasure, Bermuda is making a strong effort to tap markets closer in the United States. Bulk of the island's tourist business for many years has come from the middle Atlantic states and New England. New York, New Jersey and Pennsylvania account for 90% of the traffic with New England leading contributing visitors 22%.

Potential Market

The area now attracting Bermuda's attention is the east coast corridor in which include Illinois, Indiana, Michigan, Ohio and Wisconsin. This area has provided only 8% of Bermuda's business, but its size and accessibility by jet makes it a rich potential market for Bermuda. New airline scheduled also will offer a 7 a.m. departure from Chicago with arrival in Bermuda at 12:30 p.m. Service to New York, but the island's trade development board is seeking direct airfare flights from Chicago.

The development board recently opened an office in Chicago to promote business in the Midwest.

Redupping of travel patterns by the increasing jet transport has even brought Miami and Bermuda into competition for tourist business. During the last half of 1960, Miami attracted more tourists from east of the Mississippi than from the western U.S. This was coming into Bermuda's territory and the island's new governmental program is partly designed to counter this competition. The development board uses the California as a focus market and for the first time this year is advertising in a California magazine.

90% Load Factor

First jet service between New York and Bermuda was inaugurated in March 1961, by Pan American and in August 1961, by Delta. Delta DC-8's operated with 90% load factor last month. PanAm's jets cut into the prime mid-weeking competition of Eastern Airlines Bermuda Express service. Campbell and Eagle Airways of Bermuda. During two off-peak months last year, Campbell's load factor on its DC-7B and

Lockheed 1049G equipment dropped into the twenties. Last year Delta's jet ran for a couple of peak weeks months but, being presently short of jet equipment, withdrew them. Plans are to combine the jets the weekly EOAC last month began daily jet service with 737-400s.

Load factors on Eagle's Viscount and Britten-Norman helicopters will not be too far from the face of jet competition. But Eagle has a unique advantage it was not a member of International Air Transport Association and its last lower than the other carriers. Eagle's weekly trip rate from New York is \$55 round-trip, whereas the other airlines charge \$101 per person and \$115 per item.

However, Eagle showed LATA last December-reportedly, never pressure from other carriers and to offset the threat of a fare cutting war. Its new fare effective next week is \$65, and drops two hours from New York, but been men of back from late afternoon to about 9 p.m. This means arrival in Bermuda at a time approaching midnight. Eagle still has a fare advantage over the other carriers, but on Oct. 11 all of the airlines plan to introduce special excursion fares good on certain days of the week through May 15. These fares are \$45 jet, \$55 per person.

Operation of the average flight is most conveniently available to Eagle, thus it would be to the other carriers because Eagle at Bermuda-based and no crew layovers are required.

The airlines offered 161,156 units between the U.S. and Bermuda last year. I guess for the first three quarters of the year was 120,512, a total expected to increase to 192,512 this year.

Average air passenger last year totaled about 106,600. Another 40,000 visitors to the island arrived by cruise ship and about 11,000 were by regular ship. About 33% of Bermuda's air passengers are from the U.S., about 11% are from Canada and approximately 2% from the United Kingdom.

A major difficulty in selling to the midwestern area has been the problem of prime conventions. Participants from such cities as Chicago were usually faced with an overnight layover in New York. But now the jets and overnight schedules make such a layover possible.

Auto Censor Censors

Since Bermuda is wary the advent of jets early. They have a possibility that the character of Bermuda's tourist attractions could change drastically if a mass market were to descend on the island.

"We don't subscribe to the myth Bermuda is a haven of New York," a trade development board official said. The average visitor to Bermuda stays seven or eight days and the possibility of a flood of one-day visitors detracting the island's beaches makes Bermuda shudder.

Recently, Pan American brought two chartered DC-8s to the island where



Sheremetyevo Air Terminal Planned

Artistic conception of new Russian terminal which the Soviets are planning to build at Moscow's Sheremetyevo Airport has been provided to Pan American's Sheremetyevo terminal. Present main passenger terminal, in use for five years, says no longer "suits us in data demands," according to G. Blum, chief architect of the Sheremetyevo Design Institute. New terminal will be a two-story building of future concrete. Second floor waiting rooms will have no more than 10 rows of seats. Board building is five-story, although not identified, apparently is the restaurant and visitor's lobby.



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personnel of a New England cruise spent the day tanning the island while tanning here the same night. The very emphasis is thinking of relaxing a sun-bath in London.

But despite this possibility raised by Bermuda's close proximity to the U.S., trade officials do not favor a heavy traffic expansion such as is taking place in the islands south of Bermuda. It is not likely to be made to Long Beach much as it is. Hand both through last year ended 4,400 with the completion of a new hotel this summer the hotel will be about 5,000. It is not expected to get considerably higher. The new hotel is the first since 1918, with the exception of one new hotel that replaced another destroyed by fire.

Added Jet Service

Another jet service to Bermuda will begin this month when Constellation Mexico joins the Hibernian Constellation on the run between Miami and the island. These airplanes are being provided by CMA Mexicana de Aviacion as part of an equipment conversion arrangement among Mexican carriers.

Canadian traffic to Bermuda and the Caribbean will be affected now, however, by the new Trans-Canada Airlines' new Vickers Vanguard turboprop. Special excursion rates from Montreal, Ottawa, Toronto to Bermuda will cost as little as \$99 round trip, compared with \$141 elsewhere at present. From the Canadian cities to Barbados, round-trip economy, excursion fare will be \$108, down from \$265.

Airfare rates offered between Canada and Bermuda totaled \$1,470 for the last nine months of last year. The total this year is expected to be \$1,554 for the same period.

Full Passenger Load Carried on Tu-114

Moscow-Kiev-Tu-114 has made its first journey from Moscow to Kiev with a full load of 173 passengers—31 adults and 142 children. The 4,100-mi. trans-Siberian run was made during the night of Nov. 9-10.

The four-engine turboprop carried two complete crews which relieved each other every 2½ hr.

Soviet officials have again promised to open regular Moscow-Kiev-Tu-114 passenger service shortly. Such operations were first scheduled to begin in 1958. Latest round-trip date for scheduled Tu-114 passenger flight was January 1961. (AW Nov. 26, p. 59). Tu-114s have made frequent Moscow-Kiev round-trip flights carrying cargo and postal passengers loads.



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United Technology Builds Larger Booster

By Russell Hawkes

San Marcos, Calif.—More than five years ago, the future of United Technology Corp. is the development of aerospace, commercial and space launch space-based launchers at the company's \$30-million research and development facilities here and at nearby Mojave Hill, Calif.

The confidence has grown so quickly and with so little fanfare that many observers will be surprised to learn that United Technology is not a rocket company. Yet UTC President Lt. Gen. Donald L. Pett, USAF ret., claims the firm has the most advanced in the solid rocket booster and an capability of handling the largest motors now produced.

The UTC still has been in operation for only two years. During that time UTC has been equipped and operated with money supplied by the parent company, United Aircraft Corp. As yet, the corporation has not any large contracts to record this recent report and Gen. Pett considers that it will be years before the returns equal the cost of the elaborate facilities. However, the spending development center near Mojave Hill is not reaching 100% operational status and thus is expected to step up the line of new products.

At present 30% of the research and engineering effort of UTC is devoted to the development of a family of large solid segmented solid propellant rockets in space launchers. The basic of such a system could thereby save weight, reduce cost and assemble them

into a booster system optimized for the mission on that motor.

In the future, UTC officials foresee that a large part of the company's capabilities will be used in the development of hybrid (liquid oxidizers and solid fuel) rockets. It is now building its first hybrid rocket and plans to fire it for the first time late this spring.

According to the UTC design philosophy, the technology of space vehicles should be as inexpensive as possible, even at the sacrifice of technical sophistication. This philosophy is based on the assumption that the proper use of a modular development program should be to make a rocket which will obtain the maximum payload per dollar. The history of rockets in this country shows that an effort to get maximum sophistication always increases costs much more rapidly than it increases performance figures.

In fact, some engineers have estimated that to improve the performance of one design by 5% will increase its cost by 50%. In other steps, such a ratio can be accepted because payload is very small compared with propellant system weight and a minor reduction in the latter or a minor improvement in total impulse cost increase would be an acceptable percentage.

UTC engineers agree that this is an area for the booster because the weight of the upper stages and the payload is large with respect to the weight of the booster stage. Therefore a minor increase in impulse or decrease in weight of the booster stage will have a negligible effect on the weight placed in orbit but will have quite a small effect on

the rest of the system. Such cost savings increase the weight to about twice cost advantage, thus optimization according to their analysis.

No exotic materials are to be used in the case of motors of the UTC solid segmented motor and no ultra-high temperature propellants will be used. UTC propellant research for the current segmented motor has been directed mainly toward finding propellants with better physical properties and lower costs which can still approach the specific impulse and density of current solid-core propellants.

To the size range that most interests UTC, the "design" of propellant can be their own weight in a serious problem. In the case of the hybrid propellant, researchers are seeking higher test strength. If all efforts fail and no better physical properties can be obtained, UTC officials believe segmented rockets can still be built to larger sizes than conventional rockets. If a rocket in other fire develops in one segment, a control propellant port the segment port and only one segment need be replaced rather than a whole booster. Conventional steel will be used in the case of segmented motor and separator and basic materials probably will not be very unusual though research is being conducted in that field.

Vehicle Cost

About one-half to two-thirds of the cost of a solid propellant launch system is in the vehicle shell and the remainder is in ground equipment. Therefore, vehicle optimization pays larger effect down than in liquid propellant launch systems in which ground equipment accounts for the larger part of system cost. Contrary to much of the early thinking on the subject, UTC officials believe have concluded that the best plan for liquid propellant rockets in space vehicles is in the upper stages, where maximum performance is now required. Then operations studies indicate that the cost per pound is not as high as with liquid propellant upper stages now actually in orbit. As a result of the cost for an attached launch system. According to five oil companies, the lowest cost jet engine in orbit for chemical rockets will be between \$20 and \$300.

The chief purpose of the segmented rocket concept was to allow larger rockets to be transported by using them in sections and to get maximum costs through the flexibility of a building block concept. The purpose of the UTC concept design is to enable seg-

Capabilities

mented rockets to be built to the maximum length, thereby increasing the range of flexibility in application.

This segmented rockets have internal bearing girth designs, but unlike most conventional solid propellant rockets the hollow charge ports are neither either dies nor slotted. This is made possible by using variations in the design of the propellant interfaces at the segment joints to provide the extra internal bearing was usually provided by silents and dots in the slotted charge ports.

Segment Size Limits

UTC engineers estimate the limit on the length to which cylindrical segmented rockets can be built is set by the fact that as hot gas flows down the charge port toward the nozzle it is continuously accelerated by the addition of more gas from the propellant surface over which it flows. When the gas flow passes Mach 0.4 or Mach 0.5 the onset of cavity burning and instability.

The conical design is intended to avoid cavity burning by increasing the cross-sectional area of the port to accommodate the increased volume of gas as it approaches the nozzle. The UTC engineers estimate this diameter can be built in position at a least on one.

The next limit is imposed by the natural bending frequency of the rocket. When added length brings the bending frequency close to the natural frequency of the rocket system, dangerous vibrations result. When this limit is reached the long rockets can be designed to increase their stiffness. The effect of designing it is to increase the strength so much that the complete system is redesigned with respect to the stiffness required. This is true whether the design is to lengthen the rockets or the shorter. UTC engineers claim larger diameter and lighter weight to a solid propellant rocket because the 100-psi chamber pressure are still the best and stress the case must be and actively make design fittings can be used to grip the strong individual tanks in the structure. Another reason for the attitude is UTC that rocket segments become tolerably sufficient at diameters near 20 ft.

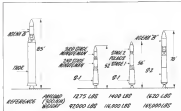
The cone angle of the UTC segmented rocket is much smaller than it appears in drawings and is scarcely visible. The cone angle for present designs is about two degrees. For larger rockets, the angle may prove to be even less and much smaller rockets may have cone angles as large as four degrees. The conical shapes will have



LARGE CASTING and coming over at UTC developed center near Mojave Hill, Calif. The core has a inside diameter of 33 ft. and a depth of about 50 ft.



IN-BOARD cooling area is viewed from above. A large liquid test stand (below) for early heavy metal system was first to be put into operation at the UTC development center.



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prepared by Monsanto Research include polycrystalline silicon arsenide (now used in Hall-effect devices such as watt meters) and both single-crystal and polycrystalline gallium arsenide for tunnel, parametric, switching, and Zener diodes.

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- * Inorganic Polyurethanes
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You are invited to work with Monsanto on your material needs in the above fields.

ner to fill the big motor to be used in the large air ground tests. A large amount can be put in about one day. Two motors are used at the development center with kinetic motors up to 14 ft. in diameter.

There are also liquid propellant rocket facilities at the development center but the largest jet used is designed for a level of 50,000 lb. thrust and has plumbing adequate for 500-sec. firing. This stand will be used in hybrid motor tests scheduled for next spring. Advanced propellants including liquid oxidizers and fluorine-rich oxidizers are expected to get hybrid specific impulse up around 300 sec. UTC motor in hybrid is possible for big booster applications and that will probably include early interest in some non-catalytic oxidizers and other fuels.

Interesting solid propellant research at UTC includes a plan to produce propellant grains of spherical propellant pellets.

NASA Asks for Bids To Build Simulator

Washington—Construction interests are being asked to bid on a two-phase program to design and build a simulator and dynamic test chamber at National Aeronautics and Space Administration's Goddard Space Flight Center.

Bids for the job, expected to cost \$7.1 million for construction and equipment are due Aug. 30. Design phase will begin when the contract is awarded and will be completed by August, and construction of the full facility must be completed by Oct. 15, 1967. Contract for instrumentation will be awarded in a separate competition.

The system will consist of two test area chambers, each with a 30-in. by 40-in. test section able to accommodate weights up to 40,000 lb. Space environment simulation chamber will have a vacuum pressure of 10^{-5} mm of mercury following a 24-hr. pumping cycle. Pressure of 10^{-4} mm of mercury must be attained in four hours.

Diffusion pumping will be done by 24 3-in. pumps and provisions will be made for cryogenic pumping to control wall temperatures from -150° to 212°.

Specifications call for a solar simulators with a plan or near normal incidence of 10% and 5 deg. collimation. In terms, range variation will be from 0.1 to 4 m/sec.

Instrumentation will include a mass spectrometer, 100-channel tape recorder, 100-channel analog to digital converter, and 400 channel data logger.



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The entire arsenal of scientific weapons is now being aimed at the more sophisticated weapons in our defense arsenal: the computer. The need there is for special purpose computers engineered to fit system requirements exactly. Serving as the nerve and intelligence center, the computer is playing an increasingly important role in system performance and reliability.

A prime Sperry candidate is a computer technology with digital and analog. In the aerial field the B SE benchmark navigation computer is a combination. Although digital algorithms include a computer measures computer which sorts out the aircraft's "conditioned" data, decides, typically, the best means of controlling a "Amphib" is a semiconductor radiation sensor, ultra-thin compact for mobile guidance. In computer technology, Sperry memory drives, most advanced in the field, include an air bearing, fixed-head type with extremely long life and high storage capacity. Another type

Techniques are demonstrated in studies and design for the future...
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On the surface, a small digital computer for ground support equipment checks out a complete airborne reconnaissance system. The "building block" computer is unique in its universal adaptability for

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In its computer work Sperry is often joined by Kongsberg Rand Unisys and Ford Instrument Company plus computer divisions specializing in semiconductor and solid state devices. General Officer David Neik, M. Y.

[illegible]

AERONAUTICAL ENGINEERING

Glass-Fiber Blade Boosts Endurance 70%

By David A. Anderson

Blountfield, Conn.—An all-glass fiber rotor blade is being flight-tested on an H-1B helicopter here as part of a development program by Kaman Aircraft Corp. to improve blade fatigue resistance and reduce vibration costs.

Next step in the program will be technical evaluation by the U.S. Air Force, which the company hopes would lead to production of the blade and retrofitting of B-57s already in service.

The new glassfiber blade, being one of the two intermediate ratios of the H43 series, is identical in dimensions and physical properties to the other composite blade fabricated from laminated spruce and maple. But it shows a 70% higher endurance limit than the standard blade, and so production would cost substantially less.

Experience Factor

Konan's experience with the blade design and development program, plus the company's close work with glass-fiber parts for production helicopters, is expected to further benefit its entry in the Army Light Observation Helicopter competition (AWM Mar. 5, p. 26).

Key to the strength of the outer blade is IM Scotchpak cloth, made by Minnesota Mining and Manufacturing Co., which has undirectional fibers. This cloth has parallel filaments in about 70% glass, and has an ultimate tensile strength of about 75,000 psi.

In addition to the high ultimate strength of this particular fabric, there is a major advantage in being able to tailor the achieve strength of a rope blade by orientation of the fabric. A structure can be fabricated to show maximum resistance to tension loads at one portion and to tension at another, with optimum distribution of stresses between.

H-43 Water Block

This is the case with the Kaman H-43 rotary blade. There are two highly stressed blade regions: the repetition area at the root, and the torsion arm, lying between the blade's servo flap and the root.

One major reason spurring development of the glass-fiber blade was extension of the flight envelope for the rotor system. The intervening Flettner-type rotor had to increase its load-carrying capability, considerably, as the helicopter itself grew heavier. The

H-15A to the B model now in production. Increased loads meant higher stresses on the blade, and it was quite obvious that existing composite blades would need strengthening, if not even being replaced.

So step by step a new blade design evolved from additions to the composite blade and profiled development of structural components in Korean engineers. They first tackled the problem of the retention area reinforcing the gap area with a dov. thick pre-molded chord, added to top and bottom of the simple chord plate.

Purpose of the reinforcement was to increase the vibration fatigue loading capability.

This was not enough to handle further



GLASS FIBER ROTOR BLADE has been developed by Kaman and is being flight-tested on an H-46 helicopter. Blade is completely constructed of 70% glass fiber, with structural properties of the spar tailored to match the stress envelope. Section aft of the spar is non-structural, duplicating geometry of standard composite blade used on H-46.



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removed because it is so heavy and its grain structure. Next, a finishing or cleanup of $\pm 45,000$ microinches, 10% higher than the maximum measured roughness during the high-speed light roughing.

While the redesign of the tool set has been under way, timing steps were taken to make the trison section. The original composite blade split, made of epoxy and acrylic laminations, was replaced with a leading edge of 0.018-in. stainless steel to protect against erosion and to take a portion of the loading and tension loads. By supporting the rest of the main glass fiber around the leading edge, the composite bond was located substantially. The C-shaped wrap and the stainless steel leading edge cap were replaced by a synthetic Dupont which better suited the end-use environment.

Final step was to replace the Dupont with a smooth D-shaped gap section fabricated at a 10-hour scratchless zone, section loaded to a 15-Seal glass fiber vertical web. The binder was removed in concentric.

With both the trison and tension areas completely redesigned, the acrylic glass fiber, the stepped area step was to do the entire blade that was. These two sections were incorporated in a new blade design which added to them an all-glass leading edge, surface, depicting geometrically, each structural element of the old composite blade in glass fiber. This was the final blade.

Testing of the design followed the standard pattern of wheel and roller tests and loads up to 4-lb and -8-lb. Endurance level at 50 x 10⁶ cycles was determined to be $\pm 1,600$ microinches, 70% higher than the composite blade. The finished blade is presently in lead the gap and the characteristic ground roller of laminated glass fiber on the gap. Color pigments are used during fabrication in this, a new aid for simplification, finishing.

Kamen's experience with glass fiber parts is not confined to black, cross-hatched pattern of composite structure of the 10/100. Borehole technology can make from the material. But the same blade is currently the first example of the use of glass fiber intended to do a specific job and to protect better results for less cost.

There are more advantages in using glass fiber for part production, and these have been demonstrated many times previously. The low cost of both the adaptability of the process to low cost production for quantity, mass to prototype and almost production, and run repair in the field have all been noted.

But there are some drawbacks. Kamen discusses one there is a need for standards for the materials, and

the quality and physical properties. One can successfully get an existing material. But the control of the trison or loading process is repeated because the strength of finished parts depends largely on the processing.

Challenges in control in fabrication and the repair can be in play and adjusting a production facility. There may be need for primary and secondary drying and curing up front because of some of the chemical imbalances used in the process. But with special attention paid to quality control and with the leading edge area, the material is designed. Kamen feels the glass fiber parts are the best choice to high-volume production of composite.

Superheating Reduces Skin Friction Drag

Major reductions in the friction drag of a hydrodynamic body have been achieved in tests at Cavendish Division of General Dynamics Scientific Research Laboratory, San Diego, Calif.

A superheated liquid body was tested with water at 20 lps. The reduction in skin friction drag, caused by the superheating of the gas formed in contact of the hot body with the water, amounted to more than 90%.

The superheating technique is one of several methods that could be used to achieve the same results. The gas could be fed from the leading edge of the surface, or the body could be heated by a flame or by a heater. The body could be heated by a flame or by a heater. The body could be heated by a flame or by a heater.

The approach is an extension of techniques which have been used to permit study on surface velocity. Research engineers have reported significant reduction in the friction drag of heat bodies by injecting high-pressure vapor heated stress through orifices at the rear of a ship.

Fluid technology has been suggested as one method of reducing the skin friction drag of a hydrodynamic body. (AWT Feb. 6 p. 20). National Aeronautics and Space Administration tests report up to 50% drag reduction in regions of high velocity and low viscosity of a test model at Mach 1.

Current tests were made with a graphite shape 18-in. long and 14 in. in diameter. The graphite model was heated to 1,000°F. Below some tests in the heating tank.

Applications of the technique could be made to other a panel hydrodynamic body, such as an underwater vehicle, a torpedo or submarine, or to a vehicle that traveled into part of its trajectory in the water, such as the Polaris missile.



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Army Seeks Helicopter Overhaul Savings

By Worth, Tex.—Good maintenance aimed at an aircraft starts with careful attention by Army engineers of the manufacturer's engineering department to ensure that detail design work is correct and correct from the first time down on paper. Lt. Gen. William D. Bowler, commander, U.S. Army Transportation Materiel Command, told final American Helicopter Society studies here.

Many detail design errors, either from mistakes on the part of the chief engineer or largely responsible for leaving TBOs (time between overhaul) periods down and ensuring that they increase at an appreciable slow pace," Gen. Bowler stated. He said that designers should bear in mind during their original thinking is a new aircraft design for Army that 1,500 to before extend of two change components is the goal to shoot for at the start rather than an achievement to be accomplished during a post-plus modification program since time at the start after the aircraft enters operational service.

Spare Problem

Army engineers in the past in specific spare requirements for aircraft parts suggested that actually, several out to be so critical as to preclude capability of producing with certain spare purchasing needs, Gen. Bowler indicated.

If 1 has a set of spare transactions then the TBO expense item will more favorable than considered, then I'm stuck with the aircraft," he noted.

In some instances, studies indicate that component reliability records show such a marked increase, that for all intents and purposes Army might as well buy a particular system concept either than attempt to stock everything needed to be safe, and economically this appears to be highly preferable.

Example of Savings

As an instance of how increasing time between overhauls of major components can result in marked saving of Army dollars in costs the HU-1A with an estimated \$150 per flying hour as against \$684 TBO. If it attains the goal of TBO to be increased for less—1962 costs will be down to 53 per hour and if it reaches the 1,000-hr TBO mark considered for January, 1965, costs will be down to 36 per flying hour.

A series of cutting maintenance costs and increasing safety by development of an aircraft "self-maintenance" program was suggested by Gen. Bowler. Recently, the concept would entail modification of electronic equip-

ment in Army aircraft. Systems would record vibration, temperatures and other parameters so some components would along the lines of engine oil level systems which have been noted in spotting equipment problems in flight. This prevents replacement prior to their becoming a safety hazard or at a time convenient to maintenance personnel.

Gen. Bowler noted that this so-called "data" plus a new being studied as

broadsheet form for an HU-1. Currently, what is the transfer of policies desired. Army plans to have an operational system ready for installation as all HU-1 in 1962. The program calls for data to be transmitted to the ground to cut down on the "Mad" box, weight and use. Such a system is conceived as eventually eliminating need for current formal time between overhaul requirements.



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PRODUCTION BRIEFING

Western Electric Co. has received two Army contracts totaling \$6,200,000 for work to be performed on the Nike Hercules missile system. The first award for \$5 million covers production of ground equipment, the second for \$1.2 million is for production of missile test equipment.

Wyle Laboratories has secured a \$482,710 contract from the George C. Marshall Space Flight Center for a high accuracy flow meter for use with liquid hydrogen. The work will include a study of the state-of-the-art in instrumentation for mass flow measurement, with a resulting modification of available instruments to provide accurate and reliable measurements for liquid hydrogen.

General Tire & Rubber Co. has been awarded a production contract by McDowell Aircraft Corp. to manufacture the main landing gear wheel brake and axle, nosewheel and nosewheel tire for the F4H Phantom.

Air Research and Development Command at Andrews AFB has been awarded a \$138,900 contract from the Marshall Space Flight Center in support of Saturn studies being conducted by Convair Astronautics. The funds will cover additional studies and preliminary design of the S-V stage for the Saturn C-1 vehicle.

Bondex Corp. has authorized construction of an advanced type of space chamber and associated equipment for environmental tests of satellites and space systems. The facility will be capable of testing full-scale satellites under various conditions of heat, cold and vacuum. Present backlog of orders for Bondex is \$475 million.

Chrysler Corp., Muscle Shoals, has awarded a \$78,220 contract from the Marshall Space Flight Center for a study of corrosion and corrosion prevention in the Saturn rocket. The study will entail location of all potential corrosion areas in evaluation of the effects of corrosion on the operation of various components and an evaluation of products used or proposed protective treatments.

Texas Instruments' Aerospace Division, Dallas, Tex., has been awarded two contracts exceeding \$400,000 each by Minneapolis-Honeywell for electronic flight controls for USAF Navy T-10 and Chinook Vought Scout. These contracts call for production of a non-redundant system that controls

12 different flight functions within an interval of 1-600 sec. Later models of the substrate have been used on long range Titan flight tests. The Soviet system will use own logic design but the basic techniques employed in the Titan module will be amenable.

Megady, Inc., has been awarded a \$1.7-million Navy contract to produce two operational flight trainers for the AAD IV weapon system. The trainers simulate the full weapon capability of the aircraft as well as emergency situations and instrument field conditions.

Chicago Aerial Industries, Inc., has received three defense contracts totaling more than \$2 million. Major items in a \$1.1 million order for an undisclosed number of aerial reconnaissance systems for the 1857 Crusader. Second order is worth \$500,000, calls for delivery of blade trucks to 41 New Helicopters bases. The blade truck is a safety device that balances and positions rotor blades, eliminating blade failure.

General Electric Co. has received a contract to supply 50 engines from the Vertol Division, Boeing Aerospace Co., for 50 helicopter gas turbine engines. The engine, GE's CT58-11B, is a commercial counterpart of the military T405 turbo shaft powerplant.

Solo Flight Instrument Corp., White Plains, N. Y., will provide KLM Royal Dutch Airlines with its SCAT (small flight control system) for installation in a Douglas DC-6. The SCAT system (AW Oct 17 p. 32) will be evaluated on both transport and occasional flights.

Ortholing Division of Gulton Industries, Princeton, Indiana, U.S.A.), has developed an analyzer which can measure mask flight characteristics in flight. Recently tested aboard an Army Research rocket fired from White Sands, N.M., the Ortholing thirdborn and sensitive anemometer sensed the channels of sideboard flow, proving it to find flow so accurately with the flight of the anemometer.

Air Force Muscle Test Center, Orlando, Fla., has replaced its IBM 708 computer with the faster, more versatile IBM 7090. Computers will be used for data processing and report production on Air Force Muscle Test Center's research, as well as collecting data on aircraft cockpits and controls.

U. S. Arase accepted delivery of first complete Soyuzne industrial production system from Sperry Rand Corp., Salt Lake City, Utah. The production system will be used at Boshkovo Arsenal, Alt., for training warfighters.

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F. B. R. et al. / *Neuroscience Biobehavioral Reviews* 77 (2017) 101–111

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ARMY

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vided by other Thiokol Divisions. Utah, for large engine production—RMD, for sophisticated liquid systems—Eklon, for diversified special motors. Experience gained through their development... basic laboratory research into high energy fuels and materials, new processing and evaluating methods, automatic production and quality control techniques, the most advanced and broad research and manufacturing facilities...all have added immeasurably to the progress of Rocketry, U.S.A. All can be brought to bear in the most challenging future projects of the space age.



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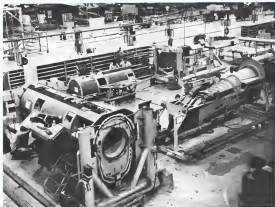
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Chance Vought is perfecting KODU-1 supersonic drone, version of the modified Republic II made for Navy and Air Force. Air Force uses the drone as a remote control target at Eglin AFB, Fla. Navy uses the KODU-1 to test Sidewinder, Sparrow and Terrier missiles of Navy Air Missile Test Center, Ft. Meigs, Calif. Recent \$8,250,000 Navy contract calls for construction of tactical version of Republic II into KODU-1 by building landing gear and making other internal changes. Dallas, Tex., assembly area is shown.

Chance Vought Produces Drones for Navy, USAF



From left, modified KODU-1 drone, as right, access panel is modified on completed nose section. Ejector seat and drag parachute are designed to cut landing rollout to less than 1,000 ft. after 25,000 ft. touchdown.

AVIONICS



SUCCESSFUL use of Non-developed PERT assignment techniques requires that initial task estimates be placed under pressure to improve schedule times, portions of regularly planned work are identified (left) as activities (right), should be done but are not as explained for project activity (right)

PERT Plan Eases Management Problems

By Philip J. Kilar

New's Program Evaluation Review Technique (PERT) has proved a powerful tool for working level engineers as well as for management. A General Electric spokesman reported at a recent American Management Association seminar on PERT:

An enthusiastic endorsement for PERT came from Ernest G. Coder of GE's Light Missile Electronics Dept. (LAME), which recently adopted the technique itself. Two years ago it did not apply it about since the board is in operation (AW No. 28, p. 53).

If PERT could do this, then it could be used for project work with an effective tool for improvement of their own performance; it would have been about worth the effort we have put into it," Coder told the AMA seminar.

But once a PERT plan has been formulated, there is one available a well-planned and executed "unlike" plan which can be used for management purposes. There is available a tool with which we can compare the quality of our operations in terms of both price and delivery. We can have these operations backed up not only with the knowledge that they are realistic and attainable, but also with a detailed plan of how to go about accomplishing our purposes," Coder said.

Henceforth, he stressed that PERT is not a substitute for setting up personal behavior by all parties involved in "managing engineering projects." PERT offers the possibility of an "ad-

ministrative group" and Coder said that management must meet the temptation to use it for that purpose.

Coder said that GE has found it moderately easy to sell its engineers and other operating personnel on the merits of PERT. One reason is that the engineers are familiar to the engineers because it is an engineering problem analysis. Even more important,

PERT is unique in its capability for properly considering, managing and providing assistance with the most important problem an engineer manages projects—uncertainty.

The uncertainties in customer engineering defense projects are compounded by the fact that the customer must be compensated on schedule cost though it inherently delays scheduling and production must follow right on the heels of activities involved in lagging for 10 to 15 years behind the state of the art as well as most other types of products.

Coder described the sort of "owner" ownership that occurred in obtaining defense contracts before the introduction of PERT and its consequences with the statement that the description was only a slight exaggeration.

A manager put up the plan, "and with most and planning, management, the engineer. So George put all the top of your head, how long would it take to get out 14 helicopters? All though the engineer knows that it should take 100 days, providing everything goes well, he kept 100 days works to enter customer's definition, but the building didn't end here. "George is not needed by the in-

fluence of the request. He knows that ultimately his estimate will show up in a contract. And because these estimates traditionally are too long, he can expect to be asked to cut his estimate. So he adds another three weeks and quotes 13 weeks for delivery."

When the 13-week estimate proves to be too long at it inevitably does since it is 13 weeks too long, the manager adds for extra effort to not deliver in 13 weeks. The manager figures he has done pretty well, because the customer, planning, would not want to cancel his helicopter order."

All the manager has at this point is a commitment. He has no estimate of potential trouble, some which he might be able to anticipate and if he were not aware of them. If the manager delays the 14 helicopters in 13 weeks, the manager does not know whether this was an outstanding effort or steady average performance. Coder said.

If the director is estimated for a fresh program, the manager may state that the customer cut the quoted delivery schedule in one week, making known as "setting a challenging goal." Despite the engineer's performance he works extra hard and ends up delivering the product in one week.

So the point Coder said the manager faces is "Hobbes' choice." The engineer has behind his original estimate in four weeks, suggesting that he did so on extending job for which he should be commended. But he has before two weeks behind the customer's stated and manager-defined delivery schedule so that a communication system approval of "late delivery."

The use of PERT encourages self-critical honesty on the part of all members of an industrial team, from management to working level engineer. When Light Missile Electronics Dept. gets ready to bid on a new job, the group as well as the work goes to gather with a number of the Engineering Resources Planning & Analysis group which Coder heads. This program provides acts as a combination of a leader and devil's advocate.

The group first develops a design plan which involves little or no technical aid, using current state of the art. A PERT schedule is then prepared and the program planner provides in random manner to ask for new estimates for each stage milestone.

"Our technical people are sharp enough to anticipate and add up expected times in their heads and will go to the critical path focusing on the way to improve it," Coder said. "It is a weakness to anticipate when the activity is known to be on the critical path. The [random] shuffling around is a procedure designed to isolate the contractor from any influence that would tend to cloud his technical judgment." Coder said.

The engineers are first asked to give their optimistic time estimate, followed by the pessimistic estimate and finally the most likely time to accomplish. At that point we have a good estimate, plus some information on what had before a measure of the uncertainty involved. Coder said. The way in which the three times on the schedule is very revealing and helps to identify the nature of the problems.

In today's market, Coder said a PERT program usually is two weeks and not too long to be scheduled to meet the contractors' stated requirements in the marketing group's estimate of what is needed to beat out competition. To answer down the first set of questions, there are several possible answers:

- **Question:** With PERT, it is possible to see where overtime effort can most effectively be applied to shorten the overall schedule, instead of working rapidly at across the board.
- **Elimination:** Certain portions of the first set of planned work may be eliminated. For example, in the design of a digital computer, the hardware construction can be improved and the design made to go directly from logic diagrams to prototype hardware.
- **Parallel effort:** Activities which formerly would be carried out in series may be scheduled for accomplishment in parallel. For example, work may be started on detail drawings before computer design has been finished and commercial testing completed.

The first level of project management is involved in the PERT work, replacing means because it is

rather than responsibility for resources and risk. Usually one session is enough, but the process can be repeated until the program has been revised sufficiently, or proved not feasible in the required time scale.

When the program goes under test, and progress comes from the original schedule, the program planner first goes to the responsible project engineer to discuss possible corrective action. The action recommended by the project engineer, with the most honest estimate, is then fed back into the act work, and the next effort is scheduled. Only at this point a higher management advised of the situation, the problem, the proposed remedial action and their responsibility.

Analysis of the problem can show that the individual engineer has reached the limits of his authority and that the reform he needs this foundation. For example, he may require additional resources or assistance from another branch area. This request action is higher management is first asked to be the PERT schedule. GE's experience with PERT suggests that important risks for its applications. Coder said.

- **Recognition of the real constraints:** The only real constraints in the cost made to the customer, all others within the PERT network should be considered as flexible provided they do not affect the cost.
- **A time estimate is not a commitment:** The PERT time estimates in the terms in which reporting level person can indicate their best technical judgment at that time. The reporting level person's estimate that, it is the error in future estimates and then will be far more accurate than the single measurement time estimate required before the advent of PERT.
- **Time estimates should not be changed to shorten an all project time schedule:** It is no longer a time to be cut, but must be brought with reality, with risk, as in managing "change plan," it is to be managed. Coder said.
- **PERT program planner should be experienced in project design:** The critical is to speak the same language as the technical project people, and also to contribute to the project plan by drawing on their own experience.



UHF Antenna to Be Used in Secor Experiment

Multi-purpose UHF antenna tracking antenna will be employed as part of ground Secor (Secor Collection of Radar Experiment) to be conducted in conjunction with the North Atlantic Treaty Organization (NATO) exercise. Antenna radiating system includes associated control and antenna structure were developed by Electronic Systems Co., Los Angeles, in cooperation with Texas Instruments, a subsidiary of Hughes Corp., which provided personnel and ground station, including of portable, weighs 600 lb., one handle two antennas of CW power at frequency in the 410-430 MHz, one receiver in 450 and 425 MHz bands provide error signals in automatic tracking in both azimuth and elevation. Secor equipment development is being handled by Calsat Corp., under contract to Army Nip Service.

Novel Semiconductor Transducer Produces Microwave Ultrasonics

New York—Novel semiconductor transducer which can generate ultrasonic energy at microwave frequencies has been developed by Bell Telephone Laboratories. The new device also can be used to convert acoustic energy into electrical energy.

One important application of the new principle will be in ultrasonic film lines for inspection where the high operating frequencies and wide band width will permit storage of large amounts of data. No standard film will find use in studying scattered properties of materials at cent high ultrasonic frequencies.

Test details on the new semiconductor ultrasonic transducer now scheduled at the recent Institute of Radio Engineers convention here by RIT's Donald J. White. He reported that hours in electrostatic film transducers can produce ultrasonic energy at frequencies ranging from 100 mc to more than 10,000 mc. Experimental units built to date have been operated at up to 500 mc and 500 v.

In a conventional ultrasonic transducer a piezoelectric crystal coated with an alternating current source, it produces a displacement in growth, otherwise with the thickness of the crystal determines its natural frequency and therefore establishes the frequency of the generated wave. Efficiency decreases as the acoustic impedance of the crystal increases and therefore limits the highest frequencies that can be generated.

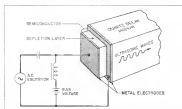
In the new RIT device a "depletion layer" formed in a semiconductor with piezoelectric properties serves as the vibrating diaphragm. It can be coated with thicknesses as small as 0.01 to 0.001 cm., corresponding in terms of frequency at 100 mc to 10,000 mc. The depletion layer is a thin region of high conductivity that occurs at the interface of two dissimilar materials such as a P-N semiconductor junction or at a nonohmic metal-to-semiconductor contact. The thickness and hence its natural frequency depends upon the amount of impurity doping and the magnitude of a bias voltage applied across the layer.

Silicon and germanium, widely used semiconductors for transistors, do not have the required piezoelectric characteristics but there are a number of compounds which do. These include gallium arsenide, cadmium selenide and hexagonal forms of zinc selenide, zinc oxide and cadmium selenide.

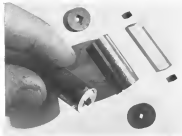
A film less, comparing the two graphic constants of a quartz and with thin germanium oxide crystal blocks attached

to either end. Along the surface of each crystal where it joins the quartz and there is a reflecting metal film contact. The opposite surfaces of each crystal have thin silver (non-ohmic) gold film contacts. (See sketch.)

A d-c bias voltage is applied across the two contacts of each crystal and an a-c voltage is superimposed upon it, as shown in the sketch. The depletion layer produced by the bias voltage is



NOVEL ultrasonic transducer capable of generating ultrasonic waves at microwave frequencies has been developed by Bell Telephone Laboratories. Device uses piezoelectric semiconductor material depletion layer instead of conventional crystal quartz. Bias voltage determines depletion layer thickness which controls output frequency.



100,000-ohm view of experimental ultrasonic drive line which operates at ultrasonic frequencies showing gallium selenide crystals (black blocks) which form heart of new type ultrasonic transducer which can generate and convert waves at frequencies from 100 mc to more than 10,000 mc. Development was reported by Bell Labs.

not in vibrating by the a-c voltage, generating ultrasonic waves which pass down through the quartz and

At the opposite end, these ultrasonic waves cause the depletion layer of the second crystal, also based for the same reason frequency, to vibrate, which produces an a-c voltage across its output terminals.

The natural frequency of a given transducer can be changed by a factor of 5:1 or more by altering the d-c bias voltage. White told the IRE. Because the depletion layer is so thin, it is inherently a low impedance device. White pointed out. For example, the

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impedance due to the expansion of the diaphragm. A vacuum chamber with a diameter of 100 mm is shown.

For most efficient transfer of energy from a vacuum source to ultrasonic output, it is desirable that the converter diaphragm have a low resistance, and that the source have a high "Q." As impedance mismatch between source and transducer increases, more of the energy will be dissipated as heat within the transducer.

Where the impedance match is good, the bandwidth of the transducer depends primarily upon the piezoelectric coupling factor of the semiconductor material used in the transducer. Gold bromide yields a bandwidth of about 3% while indium selenide offers a bandwidth of about 20% because of its greater coupling factor. However, gallium arsenide has a lower resistance, a desirable attribute for impedance match. Thus the choice of material will depend upon the application.

Experimental BTL models using gallium arsenide, which operate at about 100 mc, exhibit bandwidths of about 30 mc (35%) in output at frequencies larger than conventional ceramic transducers operating at frequencies below 50 mc. Even greater bandwidths should be obtainable at higher operating frequencies permitting a considerable increase in data-taking capability of a data base.

Experimental units fabricated today have not shown the cost, in dollars, which these products warrant. While so, however, it is evident that this is a field due to lack of experience in ceramic and fabrication techniques.



Stress-Strain Gage

New stress-strain gage can provide output while a ductile specimen is drawn in stress as well as in strain. Ductile wire and position metal strain-measuring elements are etched 90 deg apart, one of which measures conventional stress while the other yields metal component of strain caused by stress as transverse direction. Manufacturer: Bell Laboratories Corp., Electronics & Communications Div., 400 North Ave., NJ 07033-3300.

NEW AVIONIC PRODUCTS

• **Thermoelectric spot cooler**, Model T470, for spreading of high temperature elements in an engine cluster, can pump more than 20 watts of heat in moderate temperature differential at 80C between hot and cold plates, according to manufacturer. Thermoelectric cooler measures 31 x 11 x 4 in. Even greater capacities can be obtained by increasing internal resistance in an engine panel. Manufacturer: Ohio Semiconductor, 1285 Chesapeake Ave., Columbus 12, Ohio.



• **Circular waveguide emitting system**, Model STSC, for continuous 100-deg rotation of probe for measuring electrical field mode orientation is designed for operation over frequency range of 1.85 to 18.6 GHz. Operating band width is 10 to 95 mc, and rated VSWR is 1.03, according to manufacturer. Applied Microwave Electronics Inc., 114 West 23rd St., Baltimore 35, Md.

• **Fluoride electronic multiplier**, Model 3732, using all solid-state design can be plugged into any existing computer system based with 1 in. internal wiring. The multiplier all computer made by Donner Scientific, North, Irving and Co., New York. Multiplier offers three selectable modes of operation: four-quadrant multiplication with error correction of 0.1% of full scale voltage, in quadrants division, or two-quadrant squaring. Standard case size is 1 x 21 x 2 in., but unit also is available for panel or chassis mounting. Manufacturer: Donner Scientific Co., Concord, Calif.



• **Manually inserted wire tube**, Model RTK102, produces up to 40 watts of output frequency range is high as 5 kHz to 11 kHz, with an internal gain of 3,000, according to manufacturer. Tube measures 9 in. long and weighs 1 lb. Tests on experimental model indicate tube may have a life of more than two years under continuous operation in space environment. Manufacturer: Spac Electronics Co., Electronics Tube Div., Great Neck 1, N.Y.

• **Microsaturation glass diodes**, known as MICROV-G diodes, with package diameter of 0.04 in. and length of 0.06 in., employ diffusion silicon over construction with oxide passivation of the surface in addition to the glass hermetic seal. Type 102 has reverse recovery time of 30 nanoseconds. Type 110 has reverse recovery time of 100 nanoseconds. Manufacturer: Texas Instruments, Dallas, Texas.

• **Gallium arsenide varactor**, for use as a parametric in radio circuits, provides low noise microwave amplification. Device has cutoff frequency of 170 kHz, measures 1 in. dia. x 11 in. long. Application details available from manufacturer. Raytheon Co., Semiconductor Div., 215 First Ave., Norwood Mass.

• **Dual-mode transmission diode mixer**, Type WX101A, operating at frequency of 15 kHz, for use with parametric amplifier pumps, no input section and input section requiring highly stable frequency source, is housed in a 0.9 in. dia. and weighs 3.1 oz. Case is vacuum sealed and uses metal construction to minimize scattered frequency change with temperature, which modulator must be and 1 sec. over temperature range of 24C to 100C. Each output has a loaded "Q" of 5,000 and a frequency difference between outputs of 10 mc. Insertion loss is 10 db maximum and insertion loss difference between outputs is one db maximum. Manufacturer: Westinghouse Electric Corp., Electronics Tube Div., P.O. Box 284, Evans, N.Y.



• **Precision angle position indicator**, Type KT47166, designed primarily for use in automatic checkout and radar field test equipment, is available in six different models for measuring angles to within 0.0001 in. of arc. Device provides direct readout in degrees and minutes with accuracy of 1 min., is available in 2 mm and resolution of 1 mm, according to manufacturer. Device meets MIL-D-1512, according to manufacturer and is available with either vacuum tube or transistor amplifier. Manufacturer: Kevlar Division, General Precision Inc., 1150 McBratney Ave., Little Falls, N.J.

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ACTIVE FILTER CENTER

The following are based on papers delivered during the recent Institute of Radio Engineers convention in New York.

► **Reduced Radiation Effects Reported.** Effect of breed policy of military industry on radiation depends primarily on the resistance value, dose and time rate rather than the composition of the resistor, according to tests conducted at the Goddard facility at Los Alamos. Laboratory tests and reports by Dr. H. J. Degenhart and Walter Schlosser of Army Signal Research and Development Laboratories. Results of 100 ohm (unimproved) a 16,75% increase while 10,000 ohm resistors experienced only a 1-2% increase after an initial decrease of 5%. Resistors of 100,000 ohms had a 10-15% decrease followed by increases up to 14% over initial value, while one megohm resistors experienced 10-20% decreases. Most of the resistors shown in original tolerances limits of 1.2% followed after induction pulse allowed higher resistance units required 5.00 mV (AVM Aug. 5, p. 58).

► **Earth Based System for Laser Landing.** New technique for controlling the terminal phase of a laser landing in which both of the equipment would be earth-based was described by Frank B. Dickey, Jr. of General Electric, Syracuse, N. Y. An earth-based continuous wave radar system was described in which the system could provide direct and indirect range in the vicinity of the aircraft which would enable to form a regular tracking system pattern. Dickey, and Robert Schmitt equipped with two antennas and receivers would measure interval between time when two antennas transmitted the same field gradient to determine vehicle velocity.

► **New Ionospheric Scatter Mode Reported.** Evidence of what appears to be a new type of scatter communication associated with sporadic reflections from ionosphere shared with the earth's magnetic field has been described by recent experiments conducted by South Research Association under Robert A. Decker, Center upon study. The new scatter mode has a direct path which closely resembles that of meteor trails, but has a higher dB level. Ross Bollen of RADIC in Upton, N. Y. was co-conducted by James L. Heritage of South Research Association.

Daily cycle of the new scatter increases in operating frequency decreases.

► **Radio Edge Used for Traps Scatter.** The knowledge of radiation produced by an obstacle such as a mountain,

located between a radio transmitter and a receiver, can be used to good advantage in tropospheric scatter communications links. National Bureau of Standards experiments indicate Traps by A. P. Harris and R. S. Kiffin, both of NBS Boulder (Colorado) Laboratories, reported the results of tests conducted over a 140 mi path, and using Rife's Path, the obstacle is determined by using and detecting variations in atmospheric gain. Tests revealed relatively small fluctuations at a frequency of 751 mc, leading from several to many minutes which were well correlated in relation to speed variations.

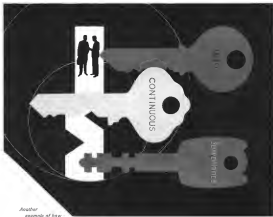
A more rapid fading of very much smaller amplitude was superimposed on the slow fade. At a frequency of 100 mc, the short term signal variations were found.

► **Army Develops New Type Radar.** Army Signal Research and Development Laboratories have developed a continuous wave continuous radar using pseudo-modulation intended to get around two limitations of conventional pulse-type radar. These limitations are that the average radar power must be increased only by increasing peak power because pulse width and repetition frequency are constrained by clutter resolution and maximum range requirements and that it is not possible to make measurements of Doppler frequencies higher than one-half the pulse repetition frequency. In the new Army radar range and velocity information is obtained with phase modulation by changing transmitter frequency for a short time during which the phase of the transmitted signal is shifted 180 deg. Returned echoes are modulated with a delta replica of the modulating signal. G. E. Rutenbach and Walter Eriksson of USARSD, is passed.

The transmitter output tube also serves as the local oscillator. Experimental results to date check with the theory of operation. The authors reported at the convention.

► **New Antenna for Monopulse Radar.** New design of monopulse radar antenna which separates both the ranging beam and the angle tracking differential mode simultaneously, high eliminating the fine gain and high resolution needed. Based in the old former channel was described by P. W. Herman and P. A. Loh of Whittier Laboratories of Southfield, N. Y. New antenna uses four stacked horns, stacked vertically, in a single aperture of hybrid nature, to provide a 2:1 difference-to-sum width of feed aperture excitation. In the other plane, three waveguide modes are used to achieve optimum with and generate a 3-dB aperture partition which normally reduce efficiency of monopulse feed. Institute of Radio Engineers was told.

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EQUIPMENT

Marines Using Helicopter Ditching Trainer

By Ronny Telly

Helicopter ditching trainer, comparable in purpose to the World War II "Ditcher" aircraft ditching trainer, is under evaluation by the Marine Corps at Camp Pendleton, Pa.

The Marine Corps, which, engaged in amphibious helicopter search training, realizes a need for training both crew and helicopter search troops to cope with emergency water landings.

Helicopters, unlike rotary-wing aircraft, sink rapidly when ditched and tend to land over due to the high center of gravity. The aviation ditching clubmembers desired that troops and crewmen must practice emergency egress from the trainer while it is in various settling positions. The portability of the door (right) side of helicopter training is the most accessible training in except through random.

The trainer was designed and built for the Marines by the Kellert Aircraft Corp., Wilkes-Barre, Pa., in cooperation with the Naval Training Device Center, Ft. Belvoir, N.Y. The device consists of a mockup of a Sikorsky HO4S helicopter which is suspended over a training tank. The interior of the trainer contains seats and safety belts for eight troops and pilot and copilot.

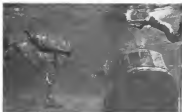
The trainer is loaded with Marines at the side of the pool and then raised and swung out over the water. Hydraulic winches lower the mockup into the water at a vertical speed of 5 ft/s. The trainer operator can raise the trainer to sink vertically to a depth of 15 ft or to roll up to 180 deg in either side. The helicopter crew, with full combat equipment, must escape from the trainer within 20 sec.

Emergency egress within the trainer period occupants to indicate using the trainer from the water within 10 sec in the event of an underwater emergency. The trainer operator, however, has a standing override which he can operate if the operator's handling is endangering personnel.

Power for the trainer's 1,500-psi hydraulic system is supplied by a 15-hp electric motor. Accumulator pressure within the trainer from the trainer from dependence on electrical power. At one time during the operation of the trainer, accumulation pressure will suffice to raise the mockup from the water. An auto safety system is built by the power of safety down on the pool bottom during training.



MARINE CORPS assault troops in helicopter ditching trainer are using over training tank prior to ditching. Ditching trainer is a Sikorsky HO4S mockup.



MARINES, in full combat dress, practice correct method of egressing the submerged helicopter which can be made to settle in various attitudes.



OPERATOR raises submerged trainer which has egressed to port. Metal grid in the view and floor of the training permit water to drain from the trainer.

ENEMY HEARTBEAT

Listening for the enemy, looking for him, smashing him—these are the aims of modern Anti-Submarine Warfare. The ASW concept is always seeking for advanced ideas on systems and equipment—in areas where Bendix-Pacific excels.

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Airborne Jet Analyzer Locates Trouble Spots

Pl. Works, Tex.—Airborne jet engine exhaust system designed to sense mechanical faults by pinpointing trouble spots and isolating them for possible engine removal is being tested by the U.S. Air Force on a Boeing B-52 and a Convair F-106.

The Houdi Instruments, Inc., seven-speed Aero-Jetjet system consists of three basic units:

- Exhaust gas temperature indicator, weighing one pound, having digital and pointer readout for readable 10-1C with an accuracy of 1C.
- Engine life measuring recorder, weighing three pounds.
- Engine temperatures and engine temperature speed indicator, weighing five pounds.

The flight pre-flight exhaust gas temperature indicator is a two-element, zero, null balance instrument in a standard two-inch diameter case, weighing both 115-400 cps at approximately 10 w, and 23 x 4 x

at less than one watt. Calibrated to the Chromel-Alumel thermocouple curve, the indicator provides digital and pointer readout to 1,200C, outstanding an accuracy of 1C with the zero scale. Accuracy is provided through use of a Wheatstone bridge in the feedback potentiometer in the zero loop. The jet is an infinite resolution indicator with the resistance element bonded into one edge of a laminated Mylar tape, the tape being punched with precision holes spaced according to the Chromel-Alumel curve laws used through a quadrant drive to the digital counter system. Digital counts

is collected in increments of two digits from zero to 1,200C. By adding the counts as they arrive, it is possible to read data to one digit, five or ten.

The temperature-compensated bridge detector compares the input signal with a signal from the feedback potentiometer, and the difference between the two, when amplified and applied to the zero motor, causes the motor to reposition the indicator until the difference is reduced to zero.

Input signals for the indicator are provided in the incoming thermocouple harness when the indicator is



EXHAUST gas temperature indicator (above) is pre-mounted in cockpit. Exhaust flame propagation (temperature speed) computer (below) auto and engine temperature of thermocouple as jet engine and those data the instrument readout when switch is actuated in cockpit.



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monitoring average exhaust gas temperature and by the flame propagation computer when the indicator is monitoring temperature spread.

Mechanical switching is accomplished through the drive mechanism in the digital counter to activate the warning light on the indicator whenever an over-temperature or over-speed condition occurs. This switching device also activates the excessive-temperature-spread flag, and over-temperature inertia counter on the recorder. At the EGT indicator is remaining average exhaust temperature; a retuning potentiometer geared to the recorder provides a signal to the engine-life-measuring recorder—the signal being proportional to the amount of engine life being expended at that specific exhaust temperature.

Warning Flag

The engine-life-measuring recorder indicates rate of the number of over-temperature conditions that have occurred to the engine; a warning flag indicates that the engine experienced excessive temperature spread and it also records the engine life measured at related to exhaust gas temperature.

At the over-temperature condition is recorded, a variable-speed motor drives the digital counter on the recorder toward zero at a rate corresponding to the instantaneous over-temperature condition. All engine life expended while operating at over-temperature is cumulatively recorded on one digital counter. The last a 5-in. x 7½-in. recorder can be placed anywhere in the aircraft compartment to ground maintenance personnel. Its warning flag and digital presentation can only be reset by ground crew.

The exhaust flame propagation-temperature spread-computer includes a switching system to test and compare

the temperature of thermocouples in an engine. The temperature of each thermocouple is compared with the other in a continuous sampling sequence using an automatic stepping switch.

On set warning cycle the thermocouple at the lowest temperature is selected and the memory circuit stores a data selector switch to that position. On the next warning cycle the thermocouple at the highest temperature is selected and the high data selector switch is advanced to that position. The difference in the temperatures of the two thermocouples is transmitted to the exhaust gas temperature indicator whereby the two lights have spread test switch on the indicator panel is closed by a light cross member.

While the warning cycle is continuous and although the lowest flame propagation changes, the temperature spread signal is stored at all times for instantaneous presentation on the EGT indicator.

When a data selector closes the switch for a check and if the temperature spread is excessive, a warning light appears on the EGT indicator and the excessive-temperature-spread flag on the engine-life-measuring recorder is energized. Following the switch results in the EGT indicator monitoring average EGT—the warning light going off—but the warning flag remaining in usable condition for the maintenance crew.

Excessive temperature spread could indicate a malfunction of fuel supply or in the combustion section of the engine, or possibly a misaligned combustion chamber or prop valve.

Helicopters' Static Shock Hazard Studied

Boeing-Canair Aeronautical Laboratory has developed equipment that can take the electrical charge out of a burning helicopter and protect ground handling crews from serious injury. Static discharges used on non-essential aircraft had proved ineffective for downing helicopters and there are many instances in which of serious injury, severe shocks of up to several thousand volts.

The compact and relatively light-weight equipment developed by Canair allows a pilot to flip a switch and eliminate the electrical "potential difference" between the helicopter and the ground. Preliminary tests using an Aeronautics helicopter have been started here but plans are to move the experiments to California where better conditions exist and a greater variety of helicopters is available.



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ENGINE-life-measuring recorder complex number of over-temperature conditions that have occurred on engine, and records life remaining based on jet exhaust gas temperature. Over-temperature causes warning flag to appear in window at left.



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Test drops made with the pneumatic decelerator by the manufacturer indicate that the device would bring a lunar payload to rest without dragging on land, rocks or sloped surfaces. Upon surface impact, the decelerator is partially deflated to cushion landing. *Goodwin Aircraft Corp., Littlefield Park, Ariz.*



Freight Container

Missouri Air Freight Inc. is putting into service a freight container designed to expedite the flow of freight in and out of air terminals. The perforated pressed steel container measures 5 ft x 5 ft x 28 in. and weighs about 160 lb.

Airline personnel will prefill the containers and roll them onto the cargo container trucks, thereby cutting down on the time the truck driver spends waiting around the terminal for his truck to be loaded. According to a study that Air Cargo, Inc., made several years ago, truck drivers spend 25% of their time at the airport—much of it waiting for loading. *Mercury Air*

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- ### CHARACTERISTICS
- | Size No.
Size | Magnetic Clutch-40 | Magnetic Brake Clutch | Magnetic Brake |
|-------------------------------|--|--------------------------------------|------------------|
| AS710-01
11 | AS710-01
11 | AS710-01
11 | AS710-01
11 |
| Power input (watts) | 3 | 3 | 3 |
| Clutch Torque (in.-oz.) | 4 (one-engaged) | 4 (one-engaged) | — |
| Brake Torque (in.-oz.) | — | — | 15 (one-engaged) |
| Inertia (gm-cm ²) | 40 (one-engaged)
30 (two-engaged) | 60 (one-engaged)
30 (two-engaged) | 24 |
| Engaging Surface | Steel | Steel and Bronze, Mineral | Steel |
| Environmental Performance | For MIL-E-8838A
300000 | | |
| Life Cycle* | 1* Operation of shaft engaged and 1 revolution of shaft disengaged, at 500RPM. | | |
- *With complete shaft
- KEARFOOT DIVISION
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Typical applications involving these Size 11 magnetic clutches, brake clutches, and brakes include service as output controls in mechanical differential computers, as motor brakes, and as speed changers and uncouplers. Korfloft can also provide magnetic clutches, brake clutches and brakes in various other sizes to suit desired applications. Components also available in sizes 3 and 5 diameters.

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172	Raychem Electric Corp. Mass., U.S.	1,000	156	Reuter Electric Co. Mass., U.S.	1,000	157	Reuter Electric Co. Mass., U.S.	1,000
173	Raychem Electric Corp. Mass., U.S.	1,000	158	Reuter Electric Co. Mass., U.S.	1,000	159	Reuter Electric Co. Mass., U.S.	1,000
174	Raychem Electric Corp. Mass., U.S.	1,000	160	Reuter Electric Co. Mass., U.S.	1,000	161	Reuter Electric Co. Mass., U.S.	1,000
175	Raychem Electric Corp. Mass., U.S.	1,000	162	Reuter Electric Co. Mass., U.S.	1,000	163	Reuter Electric Co. Mass., U.S.	1,000
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179	Raychem Electric Corp. Mass., U.S.	1,000	170	Reuter Electric Co. Mass., U.S.	1,000	171	Reuter Electric Co. Mass., U.S.	1,000
180	Raychem Electric Corp. Mass., U.S.	1,000	172	Reuter Electric Co. Mass., U.S.	1,000	173	Reuter Electric Co. Mass., U.S.	1,000
181	Raychem Electric Corp. Mass., U.S.	1,000	174	Reuter Electric Co. Mass., U.S.	1,000	175	Reuter Electric Co. Mass., U.S.	1,000
182	Raychem Electric Corp. Mass., U.S.	1,000	176	Reuter Electric Co. Mass., U.S.	1,000	177	Reuter Electric Co. Mass., U.S.	1,000
183	Raychem Electric Corp. Mass., U.S.	1,000	178	Reuter Electric Co. Mass., U.S.	1,000	179	Reuter Electric Co. Mass., U.S.	1,000
184	Raychem Electric Corp. Mass., U.S.	1,000	180	Reuter Electric Co. Mass., U.S.	1,000	181	Reuter Electric Co. Mass., U.S.	1,000
185	Raychem Electric Corp. Mass., U.S.	1,000	182	Reuter Electric Co. Mass., U.S.	1,000	183	Reuter Electric Co. Mass., U.S.	1,000
186	Raychem Electric Corp. Mass., U.S.	1,000	184	Reuter Electric Co. Mass., U.S.	1,000	185	Reuter Electric Co. Mass., U.S.	1,000
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188	Raychem Electric Corp. Mass., U.S.	1,000	188	Reuter Electric Co. Mass., U.S.	1,000	189	Reuter Electric Co. Mass., U.S.	1,000
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193	Raychem Electric Corp. Mass., U.S.	1,000	198	Reuter Electric Co. Mass., U.S.	1,000	199	Reuter Electric Co. Mass., U.S.	1,000
194	Raychem Electric Corp. Mass., U.S.	1,000	200	Reuter Electric Co. Mass., U.S.	1,000	201	Reuter Electric Co. Mass., U.S.	1,000
195	Raychem Electric Corp. Mass., U.S.	1,000	202	Reuter Electric Co. Mass., U.S.	1,000	203	Reuter Electric Co. Mass., U.S.	1,000
196	Raychem Electric Corp. Mass., U.S.	1,000	204	Reuter Electric Co. Mass., U.S.	1,000	205	Reuter Electric Co. Mass., U.S.	1,000
197	Raychem Electric Corp. Mass., U.S.	1,000	206	Reuter Electric Co. Mass., U.S.	1,000	207	Reuter Electric Co. Mass., U.S.	1,000
198	Raychem Electric Corp. Mass., U.S.	1,000	208	Reuter Electric Co. Mass., U.S.	1,000	209	Reuter Electric Co. Mass., U.S.	1,000
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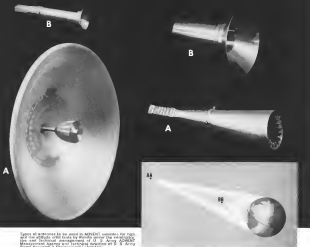
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Financial Briefs

Von, Inc., had net earnings of \$125,177 on sales of \$5,543,271 for the first nine months of the current fiscal year beginning Mar. 1, 1960. During the same period a year ago, net earnings were \$14,750 on sales of \$2,568,791.

National Ashes, Inc., operating revenues for the six months ended Dec. 31, 1959, were \$30,750,000. Operating expenses were \$35,520,319. Net loss after other income, depletion and tax provisions were added was \$4,633,204.

Litton Industries had six-month sales of \$105,392,000, an increase of 41% over last year's figure of \$74,491,206. Net earnings for the period were \$4,485,000 compared with \$1,341,008 a year ago.

Rohrer Corp. of America sales for 1958 were \$1,494,895,000, a 7% rise over 1959. Net earnings were \$55,117,800 and 15% from the 1958 figure of \$46,142,000.

Standard Kellman Industries, Inc., and its domestic and foreign subsidiaries had consolidated net sales of \$95,665,807 and a net income of \$5,499,992 in 1960. Figures for 1959 were \$75,765,423 and \$5,325,379.

The Garrett Corp. reports sales for the first six months ending May 31 of \$54,596,000 and a net profit of \$11,069 or 67 cents per share on the 1,664,371 shares outstanding at the beginning of the period.

Coringen Glen Works' sales in 1960 were \$214,671,255, an increase of 6.7% over the \$205,370,150 total for 1959. Earnings last year were \$12,054,741 or \$1.23 per share of common stock. In 1959 net income was \$14,535,999 or \$1.57 per share.

Vario Associates had sales of \$12,747,332 and earnings of \$605,000 in the first quarter of 1960. 1958 sales increased 115% over the 1959 figure of \$59,791,991 and 1958 earnings were up 31% from the \$756,716 recorded in 1959.

Control Data Corp.'s sales in the first six months of Fiscal 1960, ended Dec. 31, were \$5,543,216, and net income after taxes and a deduction of \$300,000 for product warranties was \$493,732. This compares with net sales of \$5,355,275 and net earnings of \$249,515 in the same period of the previous year when no warranty reserve provision was made.

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FULL-SCALE MOCKUP of Israeli B-101C executive transport shows third level of expense. A V-tail was part of earlier design.

Israeli Aircraft Surveying B-101C Market

By Erwin J. Bolton

Israeli Aircraft Industries is conducting a combined survey of market potential and sales and service facilities for a new line of non-stop light transport executive transport, which it says will sell for \$150,000 fully equipped.

Major portions of the engineering of the B-101C began (AWM 6, p. 37) has been completed under the direction of Dr. Elisha Shkedi, IAI's chief engineer, whose background includes positions with McDonnell, Fokker and Republic in America. Corp. A full-scale mockup of the B-101C has been completed at IAI's Lod Airport facility on completion of basic configuration design studies of which started some 18 months ago.

IAI considers, said Avraham Wertz, that their plans are to build two flying prototypes and a static test model to serve as current studies covering market, potential sales and service organizations in the United States are completed. They estimate that they can have the first flying prototype airborne in 18 months from ground.

Plus, initially it is to build the reformer in Israel, but as they begin in the United States where a distributor would prepare them for delivery to customers. Should enough interest de-

velop, indicating desirability for production here, the company says it will discuss production licensing arrangements with a manufacturer.

Better market potential for the airplane is considered to be the executive field, although the company feels that some interest may also develop among business operators.

Major Headline

IAI feels that the biggest handicap in marketing this market that far has been poor, therefore design packages have been geared to developing an aircraft featuring low cost and operating costs.

To maintain costs the completed airplane will incorporate a design meeting Federal Aviation Agency Part 35 specifications, where their requirements are adequate without duplicating FAA Part 01B transport category requirements. The airplane's layout and loading requirements are directed at achieving FAA FAR 423B jet category requirements. The plan is to build the airplane within current state-of-the-art design methods and cost new features.

Fuselage is a cylindrical barrel providing maximum strength and maximum structural strength with a single portion of the fuselage of constant sec-

tion in cross production and loading requirements. Conventional prototype fuselage construction, utilizing multiple load paths to increase fatigue life, is also refined.

Placement of engines out of the fuselage, in the style set by the Sud Caravelle, permits a clean wing and short landing gear, making it possible to enter and depart from the hangar without the need for special loading equipment.

Lowest relation to the ground is also credited with engineering loading and layout characteristics through maximum use of ground effect.

Baggage compartment located below door provides maintenance personnel with easy access to fuel, hydraulic and electrical system accessories in addition to provisions for an air conditioning equipment in the nose area, bag, which is separated from the baggage compartment by a bulkhead. Autopilot system and batteries are also located in rear compartment. A panel in the fuselage provides access to the fuel boost pumps, while two large panels in the rear permit access to main gear, navigation VHF, ILS and automatic direction finding equipment.

cockpit equipment includes Collins 17L7 transmitter and 51X2 receiver for voice communications and a

Collins 17L5 for standby. Collins 13N2 VHF receiver. Lear receiver displays indicator and Collins 51X3 receiver and Collins 331B1 course selector indicator in the navigation VOR system. Two ILS systems are programmed, one functioning with the VOR No. 1 navigation indicator and the other with the No. 2 VOR indicator. Lear ADF 280 automatic direction finder is duplicate, is placed as it is an all-weather RCA AV-10 light-weight radar and a T-100 Trucon GA-25, instrument indicator.

B-101C's electrical system consists of 35 x 40 and 100-watt 115V, 400 cps ac power supplies. The main d.c. supply obtains running power from two starter generators feeding a multi-circuit busbar.

Cabin will be pressurized at 5.31 psi to maintain 6,000 ft altitude when it is at 15,000 ft and an oxygen system is designed so that when the cabin pressure altitude exceeds 9,000 ft, oxygen masks are automatically dropped in front of passengers.

Powerplant Unit

Powerplant system will consist of two General Electric C465-2B at 2,400 lb static thrust rating at sea level, which IAI expects will be approved by Federal Aviation Agency in the end of this year. They are undrilled versions of the military-developed 1B5. The basic line plans to provide an engine exchange program for overhauled powerplants in which customers install repair on engine repair. Engines will have available an eight hour fuel system providing a total of 707 gal. Five standard wing tanks will carry a total of 534 gal. and three large tanks will carry 773 gal.

Israeli Aircraft Industries engineers estimate that the B-101C will operate with a full payload for a gross weight of 11,100 lb at takeoff from 2,800 ft runway, utilizing individual brakes and engine thrust reversers providing 47% reverse power. Landing distance over a 90-ft obstacle with this configuration is estimated at 2,900 ft at 12,000 lb gross weight and 2,740 ft (which is landing height) at 8,500 lb. Without reverse power, the landing distance over an obstacle is considered to be 3,330 ft at maximum gross weight and 2,620 ft at 8,500 lb.

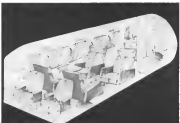
IAI considers that the B-101C's flight operations cost per hour will total \$19.95, including one pilot (at \$16,000 annual salary) total maintenance cost will run some \$32.22 per hour and total depreciation costs at some \$47.80 per hour, therefore being presented at \$15,900, compared to \$17.25, spare parts and ground equipment at \$1.75 and elevators at \$1.70. Total direct hourly operating costs are \$14.75 based on utilization of 630



THREE-VIEW shows all placement of engines, which permits short landing gear.



LOW ground clearance was dropped to about half the distance in wing. Six passengers plus baggage (shown) has two rows with auxiliary fuel tanks, compartment and fuel service area in rear. Baggage compartment located 4 ft above ground level.





THINK, ACT! How will stress of man-machine vehicle performance under long periods of stress and confinement? Lockheed/Georgia finds accurate answers in the crew makeup section of its Behavioral Research Lab—just one of the many capabilities of its highly qualified Human Factors Research Group. **LOCKHEED/GEORGIA**

Marlene George

PRIVATE LINES

Booth Boon twice retrofitted with Turbojets Atlanta 470 hp turbojet engines will be designed the Marquis. Retooling is being done by Sierra, subsidiary of Sud Aviation.

Federal Aviation Agency will hold a series of regional conferences for pilots and plane owners, called "AeroGloss" meetings, starting Apr. 11 at Santa Monica, Calif., in the Monterey Hotel. Other meetings to explore problems of general aviation will be held at Hotel St. Nicholas, Springfield, Ill., Apr. 19; Hotel Shubert, Albany, N.Y., Apr. 21 and Hotel Haddonfield, Jackson, Miss., May 2. Meetings will be held by FAA Bureau of Flight Standards and will explore possible rule-making in areas of "airframe" in various circumstances; greater control by instructors; new classes of non-pilot ratings; and special ratings for new light turbo-propelled planes.

Aero-Race air show, sponsored by Berrigo Springs (Calif.) Chapter of Citizens and Berrigo Village Airport Authority will be held Apr. 19 at Berrigo Springs. Program includes stunt flying and a parachute jumping contest.

Agricultural Aviation Engineering Co., Santa Clara, Calif., has acquired Span Flow system of aircraft dusting equipment from Minco Aviation Products.

Guide for flight test for private pilot certification has been issued by Federal Aviation Agency in preparation for increasing experimental flight planning knowledge needed for the private pilot applicant. Guide may be obtained from Superintendent of Documents, Government Printing Office, Washington 25, D.C., for 16 cents.

Booth Aircraft Corp. will make four major improvements of its new models to help owners increase operating efficiency, starting Apr. 6 at Center Aviation, Phoenix, Ariz. Paul E. Allen, Booth manager of parts and service, said improvements, part of 19th annual Boothcraft Service Clinic, will be held in 40 U.S. locations through September.

Paul E. Allen, Leesville, Calif., has started a new world gliding altitude record, flying his Schweizer 233E solo plane to 46,267 ft. over Mono, Calif., on Feb. 25. Previous record of 41,190 ft. was set in 1970 by W. Bruce S. Hunt, Jr., San Diego, Calif. Record is subject to confirmation by Fédération Aéronautique Internationale.

Executive Mustang Cruises at 370 mph.

Sarasota, Fla.—Twin-Floids Aviation, Inc., has put its North American P-51 executive Mustang into production after five years of research that produced six prototypes of varying configurations.

Evolution model is designated the Cavalier 1900 and sells for \$12,700. Based at Sarasota. The engine is licensed as an auxiliary engine, and it mounted for use with fuel tanks, holding 96 gal. each, and maximum gross weight. Total fuel capacity is 376 gal.

W. F. Besswell, vice president, said the company has 18 available airplanes and now has one on the line, plus a demonstrator. Twin-Floids also owns a T-51, the dual-control Mustang developed by U. S. Air Force for pilot checkout.

The Cavalier is powered by a Rolls-Royce/Palmer Marks inline piston engine, which includes the P-51's two-stage, two-speed supercharger system. Fisher semi-rigid engine was available at Sarasota for about \$1,800. Propeller is a paddle-bladed Hamilton Standard 240B constant speed approved for 1,200 ft. between carburetors.

Major exterior change is in the floor-



CAVALIER 1900 executive Mustang has maximum range of 2,000 stat. mi. Speed range is from 440 mph (and low) to 36 mph stall speed. Takeoff runs 19 ft. altitude is 1,919 ft.

high visibility canopy, which is used to filter the sun's rays. Wind shield is fold-down.

Twin-Floids has designed two big gear compartments as each wing to provide space for 400 lb. Gross weight is 15,500 lb. and normal cruise speed is 21,000 ft. is 370 mph.

In converting the Cavalier, Twin-Floids installed anti-ice/anti-thrust Actuator hose and fittings through the fuselage and fuel system. Electrical

wiring is applied to airframe standards, or better.

Pilot's instrument panel has been designed to include navigation and radio controls directly in front. Speed and instrumentation includes a Sport H-6 electric, non-rotating gyro horizon and the Sport C-4 Cessna compass. Precision has been made for dual cone north automatic glide slope, mini-horizon direction finder and 300-channel crystal controlled transceivers.

PROBLEMATICAL RECREATIONS 61



A prisoner is given 10 white balls, 10 black balls and two boxes. He is told that an executioner will draw one ball from one of the two boxes. If it is white, the prisoner will go free; if it is black, he will die. How should the prisoner arrange the balls in the boxes to give himself the best chance for survival?

George Peck, Engineer News from our Maryland Division: a new line of broadband antennas. Model 1221-10 covers the frequency range of 100 to 3000 mc with a gain of 5 + 1 db. Maximum VSWR 2.0-4. Model 1221-5 covers the range from 1000 to 3000 mc with a gain of 7 + 1 db. Maximum VSWR 2.0-3. Various polarizations can be provided in bandwidths of 16 to 1 or greater. Sampling people are directed to contact: Lark Systems, Inc., Maryland Division, 4900 Colver Road, Colver Park, Maryland. America to last week's readers: Let M be my age in years, S = son's age, and P = father's age. My father is five times as old as my son, therefore: P = 5S. When I am as old as my father, my son will be P - M years older than he is now, his age then will be S + P - M. Since this is 8 years more than my present age, S + P - M = M + 8. The third equation is: P + M = 100. Solving these equations gives S = 13, and hence M = 35, and P = 65.

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prints, which—made by a Copystar 350A printer—can so strengthen your engineering staff's decision after use. Write today for our free 350A booklet giving the full benefits you can expect from a Copystar 350A printer. **Haloid Xerox Inc., Dept. 4190X, Rochester, N. Y.** Branch offices in principal U. S. and Canadian cities. Overseas: **Rank-Service Ltd., London.**

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Make & Model	No. of Units	Net Weight
Boeing		
101 Super	1	
102 Super	1	
103 Super	1	10,000
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Cessna		
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De Havilland		
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OFFICIAL AIR TRANSPORT FACTS AND FIGURES ISSUE

MAY 1

Official Operating Statistics of The Air Transport Association

For the past five years, AVIATION WEEK and Space Technology has published "Air Transport Facts and Figures," the official operating statistics of the Air Transport Association.

Once again, we have been officially designated to publish the 1980 "Facts & Figures" edition in our May 1 issue.

AVIATION WEEK's transport editorial department will also cover in depth key subjects on international air transportation . . .

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Aviation Week
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Israel Delivers First Executive Conversion

First executive transport modification by Israeli Aircraft Industries, a Comair 140, has been delivered to Aliair Stora, making the firm's entry into the busy neo-ancient field.

The Tel Aviv service company converted the former Edgemoor Air Lines' transport to a 25-passenger configuration to replace a DC-3 formerly operated by Aliair Stora.

Israeli Aircraft plans to seek additional executive aircraft service and conversion business using its selling point as low labor cost—no tolls labor charges at \$1 per hour. Industries note that it can deliver additional Comair 140 conversions, retain some customer spheres on sales and engineering equipment in the United States for \$180,000, with debt applicable to labor costs only.

As an indication of its interest in executive aircraft, it has included development of a seven-passenger twin jet transport, powered by GPN 855 (AVY Mar 4, p. 57 and Apr 10, p. 195).

Aliair's Comair 140 is a straightforward conversion utilizing basic systems and engines, propellers, fuselage with Israeli Aircraft performing a semi-major overhaul comprising items covered in a 4,000 lb check and complying with all service bulletins and airworthiness directives to bring the airplane up-to-date technically with Federal Aviation Agency requirements.

Major work was in rebuilding the interior. An Israeli technician was brought in as a consultant to handle detail design of the new cabin layout and develop plans for IAI's component shops. All furniture, seats back and luggage were made in Tel Aviv except for two Berne Aero chairs.

Cockpit equipment includes a Sperry A-12 autopilot with approach computer Collins 11 BR-1 items, with two more having undercarriage Collins 11 V-1, plus, Raytheon Radio Corp. ARC 110 transceiver and ARC 110-1 radio. Power has RCA AVQ 50 vacuum tube.

Israeli Aircraft Industries was formed in April 1973 and was initially known as Redell. Operation in Israeli lands government owned, but is set up as a private commercial enterprise, with an air service conversion program in aimed at supplying a wholly self-sufficient maintenance center in the country.

An FAA approved repair facility, it also does engine and minor airframe, engine and accessory overhaul. Contract maintenance is handled here for TWA, Air France, KLM, BEA, Alitalia, Swissair and Olympic Airlines. On engine overhauls it handles everything from the Conquest C-16 up through the Wright R3300 piston propellers and various types of turbos.



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LETTERS

Bioastronautics Effort

Your reliance on bioresources in the blue economy points up one of the most serious problems: the severe limits in achieving sustained aquaculture as a profitable cost-effective. Marine scientists have been thought of as at least some quarters as concerning of the major sustainable sources: periwinkles, prawns, oysters and lobsters or perhaps. Each of these major selections has received major technical and financial support. As a matter of second order plants have been constructed to supply each one of them.

Today we are talking something that goes into space: the place of a window. There will be a manned capsule. The amount of effort required to develop a truly effective manned payload is entirely equivalent to or greater than that required for a nuclear window. It is, therefore, apparent that the manned payload must be considered a major subsystem and supported in proper proportion to the effort expended on the other parts of the vehicle. Unless this is done there is strong likelihood that the required advances will not be made. This long before the manned capsule has reached its state of development which will make the manned space flight a useful, successful achievement.

There obviously exists a need for a strong external headquarters effect geared to provide a family of patients for internal markets. That will require a long period of consistent and coherent development. Unless thought and action are carried out now to initiate such a program, our efforts in managed care flight will be severely constrained.

Time calling this to the attention of your readers is your editorial as a step in the right direction and I should like to see complete you on your mission.

Larry A. Korman
 Executive Vice President
 Spaulds Inc.
 Van Nuys, Calif.

Polar Route

The article concerning U.S. foreign policy (AEE Jan. 16, p. 16) was informative and interesting, but it touched only briefly on an area that has almost certainly gained a permanent importance in U.S. foreign policy negotiations with European countries: the European Trade Grant policy issue.

However, I would like to discuss some aspects of the study that I have. One conclusion reached by the State Department's C-48 policy of restricting the foreign day centers (opening for the West Coast market in coming years) San Francisco or Los Angeles, but not both cities. This policy is beneficial to workers the 75-80% of centers, the foreign centers, but most of all the two cities. It is a foreign and recent arrivals of the San Francisco Bay area. I know that the Air Force-Lakeview area was closely watched there by the San Francisco police and the new Air Force was regarded as something more than the

Askew Week solicits the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Askew Week, 120 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

[illegible]

Specifics An Air France applicant for a polar route to both San Francisco and Los Angeles was forced to choose between the two cities. The airport director in San Francisco was concerned and decided in San Diego personally and believably because of that city's population "advantage" over San Francisco. Just after Air France's decision (a little over a year ago), Lufthansa, having made the same application to serve both cities, was forced to refuse to fly to San Francisco because of San Francisco's lack of Air France's feared choice (a great amount of warning had been given to both cities to get Air France after the climate aid choice had been revealed, as well as the fact that TAI was also to serve Monterey only. Air France's decision was made in San Francisco, not in San Jose, San Francisco.

[illegible]

may have played an important part in the award. But the point is that the State Department is not keeping the foreign nations from carrying both Los Angeles and San Francisco traffic by limiting them to serving only one of these cities.

[illegible]

If the interferer does not occur, or if one of the subjects to raise would rather serve one of the two sides with more fights, then this is another matter. But whose rights to bank cases are assigned then, again, I see no reason to Air India.

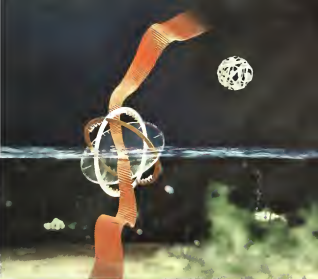
By closing, couldn't be granted traffic rights to both cities with one, but most trips from each per week instead of rights to only Los Angeles with four round trips per week. As suggested in your article, there is a strong possibility that the proposed policy when the Kennedy Administration arrives at this problem, it is to be hoped that this depressing aspect of the Great Coast gate could start to be beneficially affected by such change.

DRUCE HATHORN
Hastings, N. Y.

Inboard Spoilers

Although it is not yet reported in print, it is likely that the bird was shot on 23 May, a day after a thunderstorm, as a photograph found in its nest in the May 23 issue of *Audubon Western* (pp. 87-91). Mr. Reed says that when the released sparrow was out of the nest and the speed brake handle actuated the outboard cylinder will be depressed. This is accurate, but the method of controlling engine two (main) throttle sets will result in a pitch-up tendency of the aircraft, not pitch down as Mr. Reed suggests. The real fix here lies in the design of the CG control system, not in the design of the CG control itself, but in the aircraft upward. This is, of course, a minor correction to an otherwise fine article.

1/12, Thomas M. O'Brien
41st Air Refueling Squadron
Griffis AFB, N. Y.



Beitrag zur Performance Science — *deutsch*

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It can pinpoint a long-range missile on target. Guide a satellite or space ship to any point in the universe. Regulate the predetermined course of a surface vessel or submarine to any spot on the seven seas — by any name, however obscure.

In manned vehicles, it will give exact position — even without an atmosphere — independent of gravity, sea, wind, and weather conditions — without fixes on horizon or stars — after days and weeks of travel.

This is **Hipercass**, a self-compensating, pure inertial guidance system developed by Bell's Avionics Division. Designed for the U.S. Air Force, **Hipercass** is 90 years

file that a whole family of related systems has been engineered for application in any environment — sea, sky, or space.

The system introduces new Bell B800 gyro. Its accelerometers and digital velocity outputs are already operational in missile and space guidance systems.

Hipermas—and many other systems such as the Air Force GSN-5 and the Navy's SPN-30 All-Weather Aeronautic Landing Systems—rely on Bell's capabilities in the broad field of electronics. This diversity of activities offers an interesting personal future to qualified engineers and scientists.

Source: Adapted from the author's research.

BELL AEROSYSTEMS COMPANY
BUFFALO, N.Y.



SAC'S MOST UNUSUAL MISSILE

To enemy radar, these are all B-52's. Altitude, performance, radar return and flight patterns confirm this.

But two of these bombers are decoys . . . diversionary missiles to lure the firepower of the enemy away from target-bound B-52's.

Each SAC B-52 can carry McDonnell GAM-72 Quails in addition to its prime target bombload. By simulating the characteristics of the parent aircraft and saturating enemy defense systems, the GAM-72 greatly increases the deterrent potential of a bomber striking force yet costs less than 2% of the cost of a B-52.

McDonnell is now delivering GAM-72 missiles, launch gear, support equipment and bomber controls to Strategic Air Command operational squadrons.

For illustration suitable for framing
write: Dept. 80, McDonnell Aircraft
St. Louis, Mo.

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